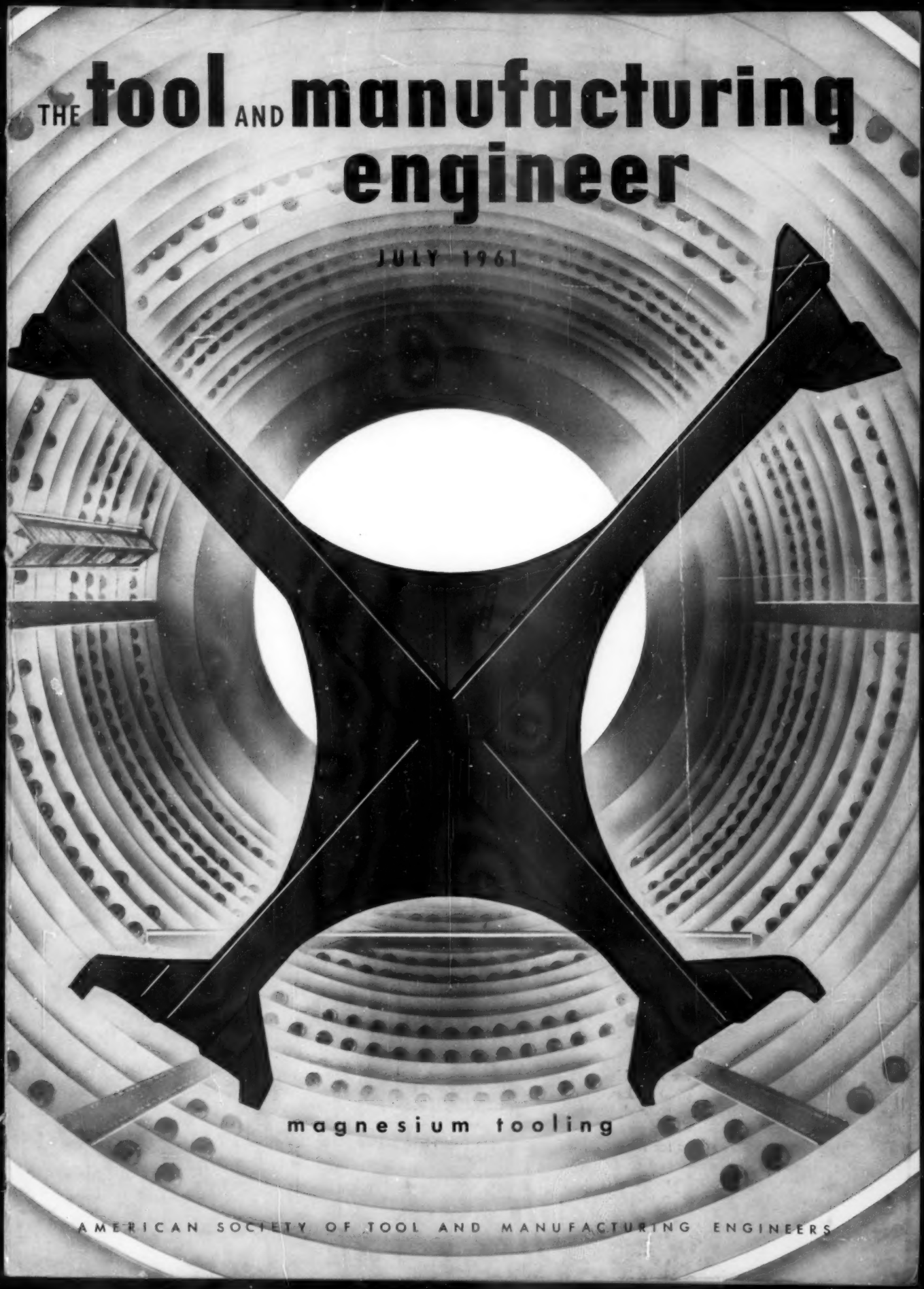
THE tool AND manufacturing engineer

JULY 1961



magnesium tooling

AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS

CONTOUR BORIZING...

Adding Accuracy for Tape Control

by R. W. Mason
Chief Inspector
The Heald Machine Company

Three years of design and manufacturing experience and an outstanding background of performance records, on tape-controlled Model S Bore-Matics, have made two things clearly evident.

First – accuracy and reliability of these contour Borizing machines have proved to be outstanding. Tolerances of ± .0001 are repeatedly obtained in routine production.

Second – these results stem from a design and manufacturing accuracy which produce a unique machine capable of utilizing the full potential of today's most advanced numerical control systems.

To obtain this accuracy in building the machine, unusual manufacturing and assembly procedures are required and exceptional quality control and inspection techniques are employed. Some of these are of particular interest.

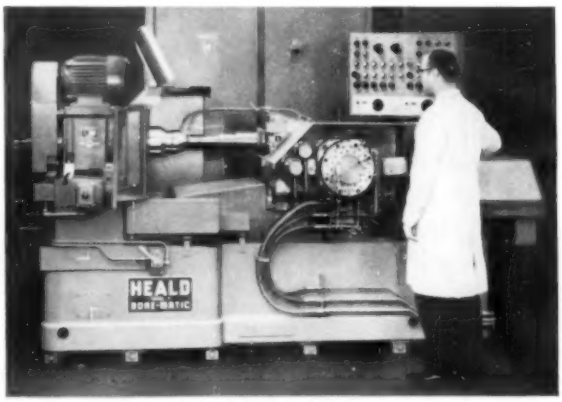
To prevent dimensional changes due to thermal effects during machine assembly, all work is done under controlled temperature in an air-conditioned room. To prevent strain and distortion, all screws on critical assemblies are tightened with torque wrenches to pre-determined design pressures.

All elements of straightness, alignment and tracking are measured with an Auto-Collimator which compares the work to a beam of light and reads to an accuracy of 0.1 of a second of arc (one second of arc is equal to .000005 per inch of length). All dimensional measurements are made with electronic indicators.

Hardened steel ways are assembled and honed in place to a straightness of .000050 or less, in their full length. Table and cross slide are actuated, in increments as small as .000025, by high-precision pre-loaded anti-friction ball screws. Bearing diameters for these ball screw assemblies are bored and honed *in place* on the machine, to assure precise alignment with the ways.

Tracking along each of the two axes is measured in two planes – horizontal and vertical – and must be accurate within .000025 in their full length of travel.

Obviously control measures such as these are not conducive to mass-production methods or other cost-cutting expedients. However, the results are well worth the extra effort. These machines track and repeat to the full potential of the numerical control system, sustaining production required for today's high precision contour boring and turning operations.



Heald tape-controlled Model S Bore-Matic for boring and turning irregularly-shaped work with a dimensional accuracy of ± .0001 or better.

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THE tool AND manufacturing engineer

July 1961 Vol. 47 No. 1

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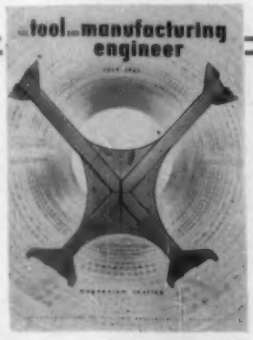
THIS MONTH'S COVER

Magnesium, lightest of the tooling materials, is finding wide application for use in machining and assembly fixtures. The fixture shown here, used in the assembly of a large aircraft fuselage, does an effective job, yet it is light enough to be handled by one man. Other applications of magnesium tooling are covered in Jack M. Hockett's article starting on Page 53.



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Let's Get Together!

Frequently, we are told that we are pricing ourselves out of the market. This has happened to industry after industry until one wonders what next and where do we go from here? Are we following a path of no return to mediocrity and loss of leadership? Notable among industries that have suffered loss of position is the machine tool industry. In a surprising few years, it has lost its position to Western Germany. Japan is also getting stronger. In another few years—five at the present rate—Russia may claim the market leadership.

The past decade has been a fantastic period of international, industrial revolution. During this period, however, our industry seemed to flounder. Policies vacillated and companies were unable to cope with intensive and aggressive competition. When we exported machines and know-how to Europe and Japan, we lost our superiority gained by mass-production methods.

There is no question but that our assistance after the war was mutually advantageous. In addition, however, our problem is to return to a favorable competitive position.

We refused to sell tools to Russia. As a result, she copies our best designs and builds them herself. Possibly, it might be better to sell instead.

In spite of the developing situation, our political and labor leaders continue to argue about the evils of automation. At the same time, many industrial leaders complain about labor rates, punitive taxes and unrealistic depreciation allowances. Both must get together. The problems and advantages are mutual. There is no labor rate that cannot be offset by productivity. Productivity is improved as automation is increased. Displacement of workers by automation frees manpower for more productive and creative operations. With the ideal situation of automation and maximum utilization of manpower, there is no competitive situation that could not be surmounted. This requires a desire on the part of industry to retrain workers and a desire on the part of workers to be more productive with less effort.

John W Greve

EDITOR

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Engineering Education

Industry wants—and needs—college-trained tool and manufacturing engineers. That's the finding of W. Karl Somers, Utah State University professor, after reviewing the results of an extensive survey in which hundreds of top executives were queried.

These leaders had definite ideas about the courses that should be taken by students in this field. A course in manufacturing processes heads the list, followed by courses in machine tool performance and manufacturing analysis. The fourth most desired course is technical report writing. A list of the most-wanted courses appears with Prof. Somers' article, which starts on Page 45.

Gun Drilling

The advantages of gun drilling—hole straightness, fine finishes and high precision—have been largely restricted to medium and long run production because most gun drilling machines require special setups and fixturing. With the advent of a new type of universal gun drilling machine, gun drilling has entered the realm of short run and job shop operations. The machine is described by Duncan J. Brown, Brown & Sharpe Mfg. Co. engineer, in an article starting on Page 51.

Magnesium Tooling

Grumman Aircraft engineer Jack M. Hockett has long experience in putting magnesium tooling to work. In his article, Page 53, he shows how Grumman uses magnesium for complex assembly and machining fixtures. Advantages: light weight and simplified machining. The magnesium fixture shown on the cover of this issue, for example, can be moved by one man since it weighs only 30 lb. Hockett also describes a 38-lb magnesium box jig that has given excellent performance in production. Grumman's experiment with magnesium tooling has paid off in six-figure yearly savings and has demonstrated, once and for all, that magnesium tooling has a place in almost any plant.

Grinding Fluids

Part 2 of Dr. Leo Tarasov's comprehensive report on grinding research starts on Page 60. He shows the effect of various grinding fluids on the relative grindability of heat-treatable steels, austenitic stainless steels, high-temperature alloys and titanium alloys. Each of these groups of metals has different grinding characteristics and these characteristics are strongly affected by the type of grinding fluid used. One finding: with some exceptions, replacement of water-base fluids by grinding oils results in a big reduction in wheel wear. This makes it possible to remove more stock with each wheel, to grind larger areas without wheel breakdown and to maintain wheel form for a longer time.

Automatic Assembly

If it is possible to control a machine tool with a punched tape, it is equally possible to control an assembly machine with punched tape. B. F. Goodrich engineers followed this line of reasoning and came up with a tape controlled tire assembly machine. The control saves the operator from having to manipulate pushbuttons, levers and foot controls to actuate the various machine functions. Result: better quality, less fatigue and more tires produced. See the article on Page 68.

Explosive Welding

The application of explosive forces has already revolutionized basic concepts of metal forming. Now explosives are being used to weld and join metals of all kinds. Aerojet General Corp. engineers I. Zernow, I. Lieberman and W. L. Kincheloe know the potential of explosive welding and joining from firsthand experience, an experience they share with readers of this magazine in an article starting on Page 75. Explosive welding can be performed without the need for conventional welding equipment—which makes the process intriguing for the assembly of space stations in orbit.

What Happened in New York . . .

. . . at the ASTME 1961 Engineering Conference and Tool Exposition is the subject of several articles in the "ASTME in Action" department, Page 79. Both the Conference and the Exposition were among the most successful in Society history.

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LOOKING AHEAD

By T. W. Black
Senior Associate
Editor

The high attendance at ASTME's recent Engineering Conference and Tool Exposition indicates a resurgence of interest in the latest manufacturing methods, processes and equipment.

At both the Conference and Exposition, attention was centered on radically new developments. The sessions on explosive forming, for example, drew the largest number of participants, closely followed by the sessions and Techtour on numerical control.

Exhibitors at the New York Coliseum reported that tool and manufacturing engineers are actively in the market for new and improved machines, tools, tooling and equipment of all kinds. This serves as additional confirmation for figures that show that the metalworking industry is rapidly pulling out of the Recession and is looking forward to good markets for some time to come. The emphasis, however, is not on expansion but on tooling up for more efficent manufacture. Lower manufacturing costs, not mere increased productive capacity, seems to be the guiding principle behind plant modernization programs.

It is evident, too, that companies are placing more emphasis on long-term manufacturing research and development. Many of the products exhibited go far beyond mere face lifts or superficial improvements. These were precisely the products that created the greatest interest at the Exposition.

✓ ✓ ✓

New developments in manufacturing are being matched by new developments in materials. Magnesium-lithium alloys, one new development, appear to be the lightest metals suitable for structural use, according to a Battelle Memorial Institute report. Some of these alloys weigh only about three-fourths as much as conventional magnesium alloys, half as much as aluminum and one-fourth as much as stainless steel. Although the alloys do not have particularly high strength—about 25,000 psi—they should be valuable in space structures that must be light but need not carry heavy loads.

✓ ✓ ✓

A limited number of copies of this magazine's 126-page book, Numerical Control Today, are still available. To get your free copy, write to Numerical Control Editor, THE TOOL AND MANUFACTURING ENGINEER, 10700 Puritan Ave., Detroit 38, Mich.

✓ ✓ ✓

Nearly everyone pays lip service to the benefits of "research" these days. A dissenter from this popular view is Dr. Maurice Nelles, engineering vice president of American Electronics, Inc. Dr. Nelles, who has had a distinguished career as a teacher and as director of research for several of America's largest corporations, points out that many corporate research organizations produce few improved or new products or processes. He suggests that many managements retain research organizations simply because "research" is fashionable. During the next decade, he says, management will start to take another look at the value of research and research executives will have to achieve high ratios of returns to research costs.

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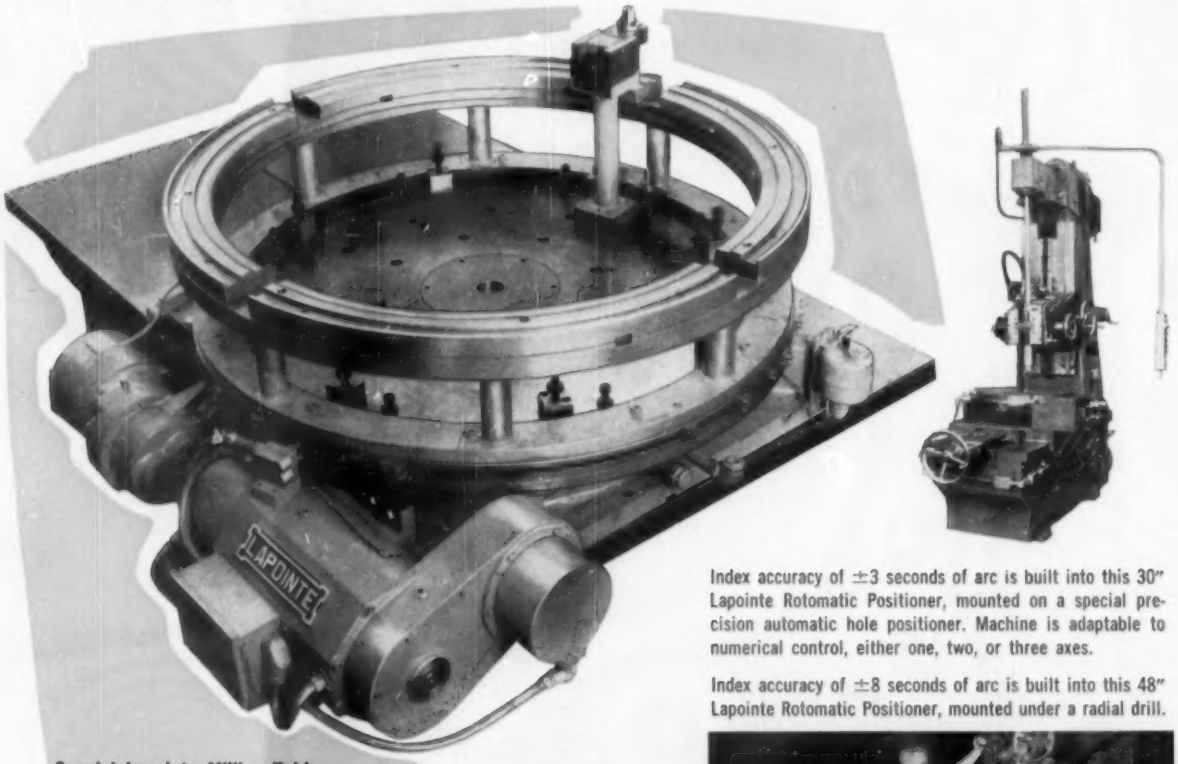

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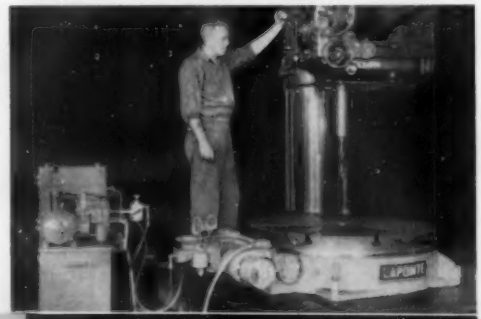

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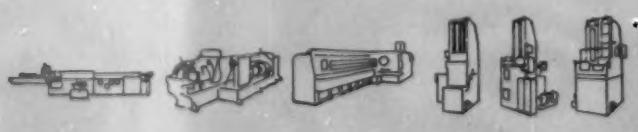

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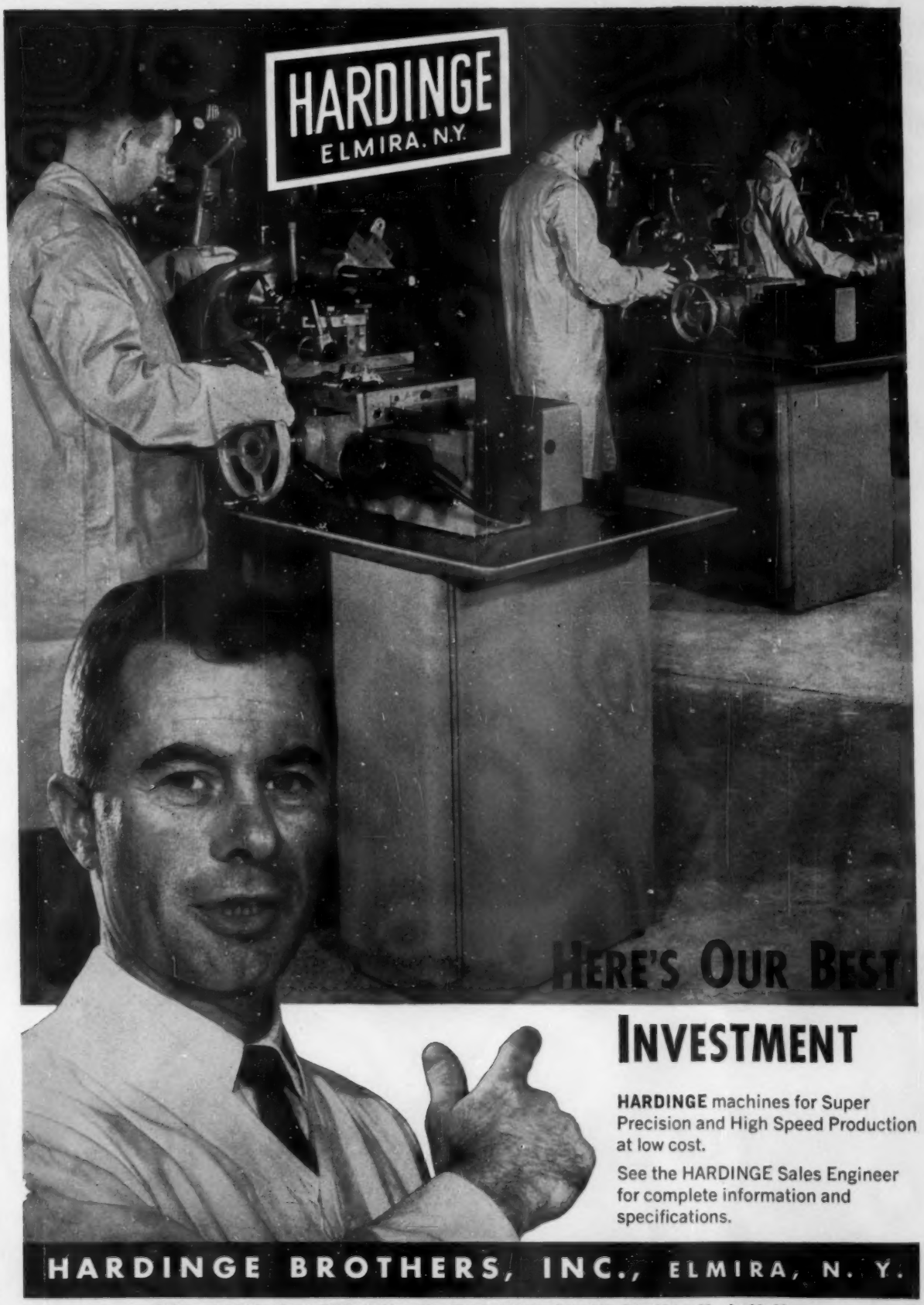

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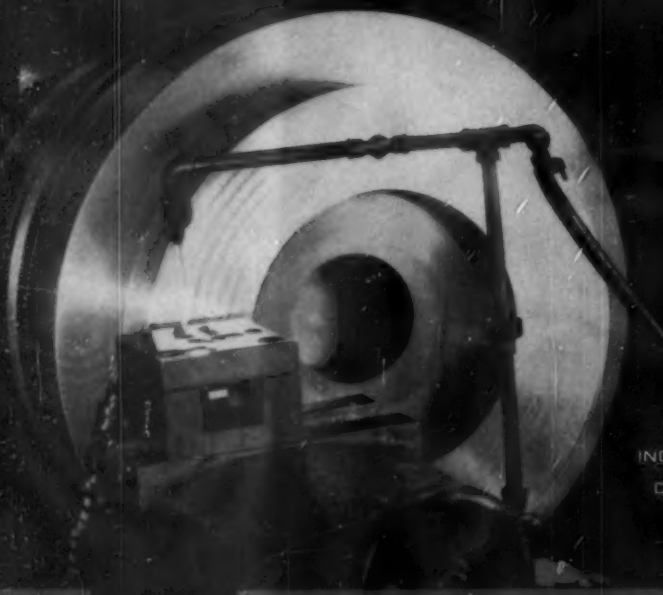

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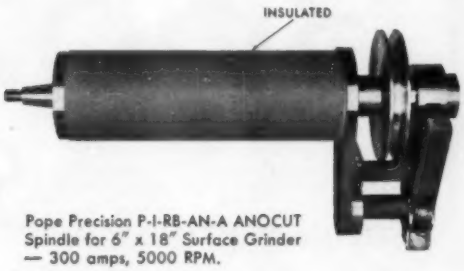

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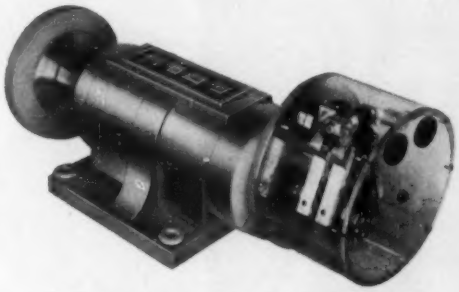

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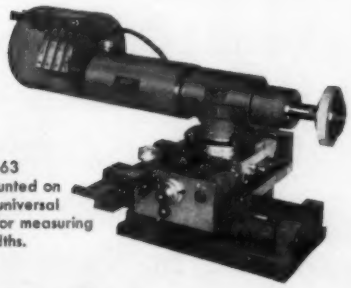

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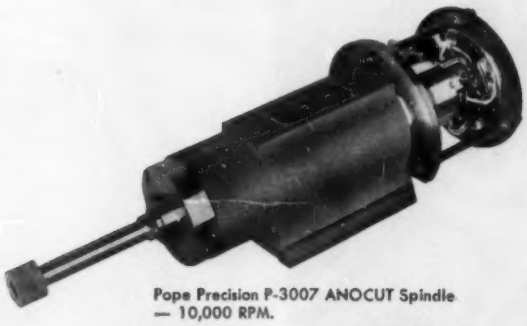

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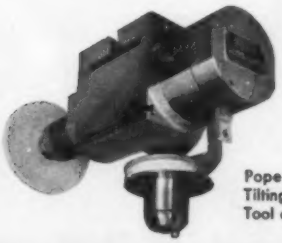

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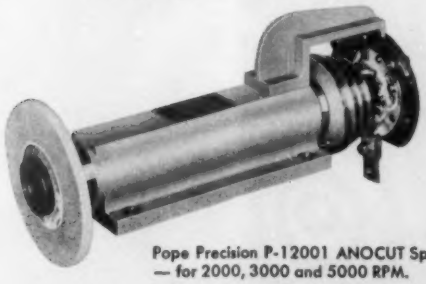

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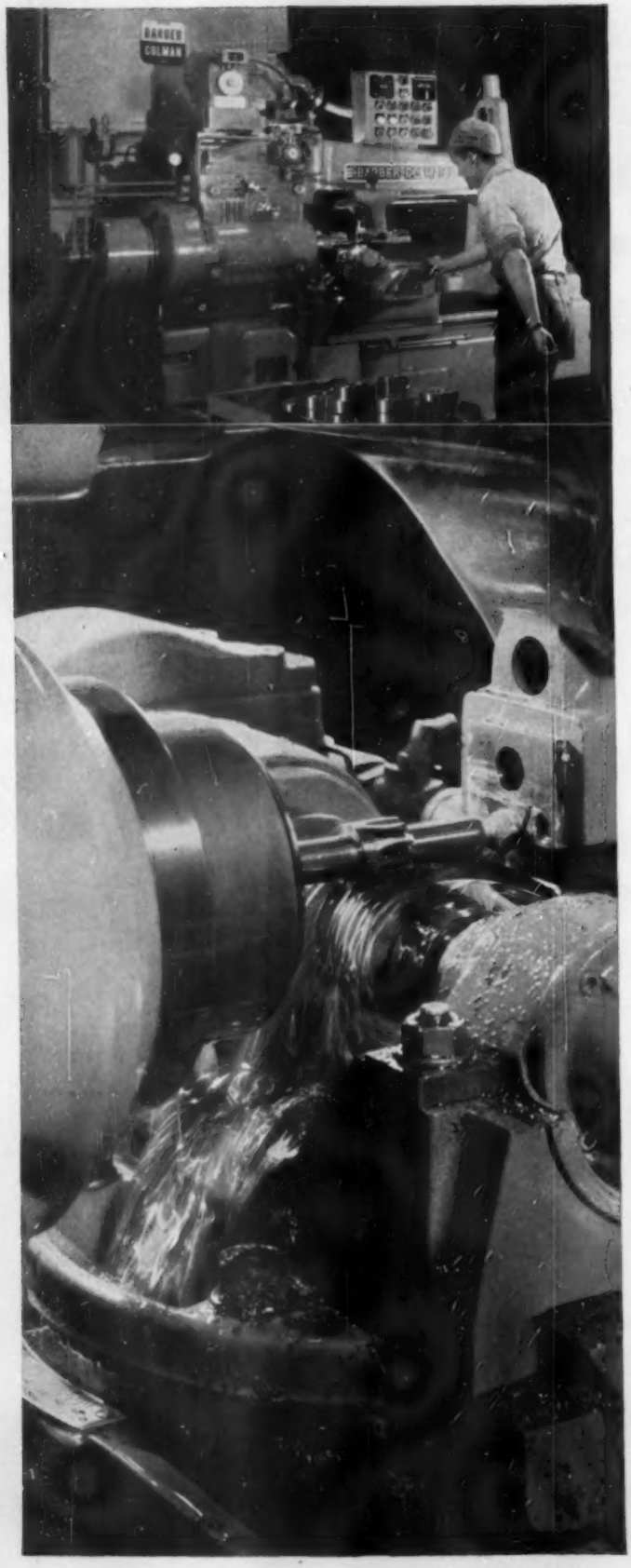

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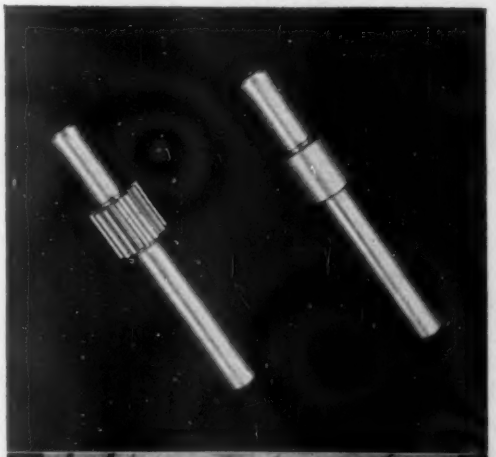

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Gardena
Pacific Abrasives Supply Co.
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Pacific Abrasives Supply Co.
Monte Bello
J. L. Axelson Company
Mountain View
Pacific Abrasives Supply Co.
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Darling Abrasive & Tool Co.
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San Leandro
Pacific Abrasives Supply Co.
Santa Ana
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Santa Monica
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M. R. Priest & Sons, Inc.

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NEW JERSEY
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NORTH CAROLINA
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The Gastonia Supply Co.

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Akron
Cunningham Supply Company
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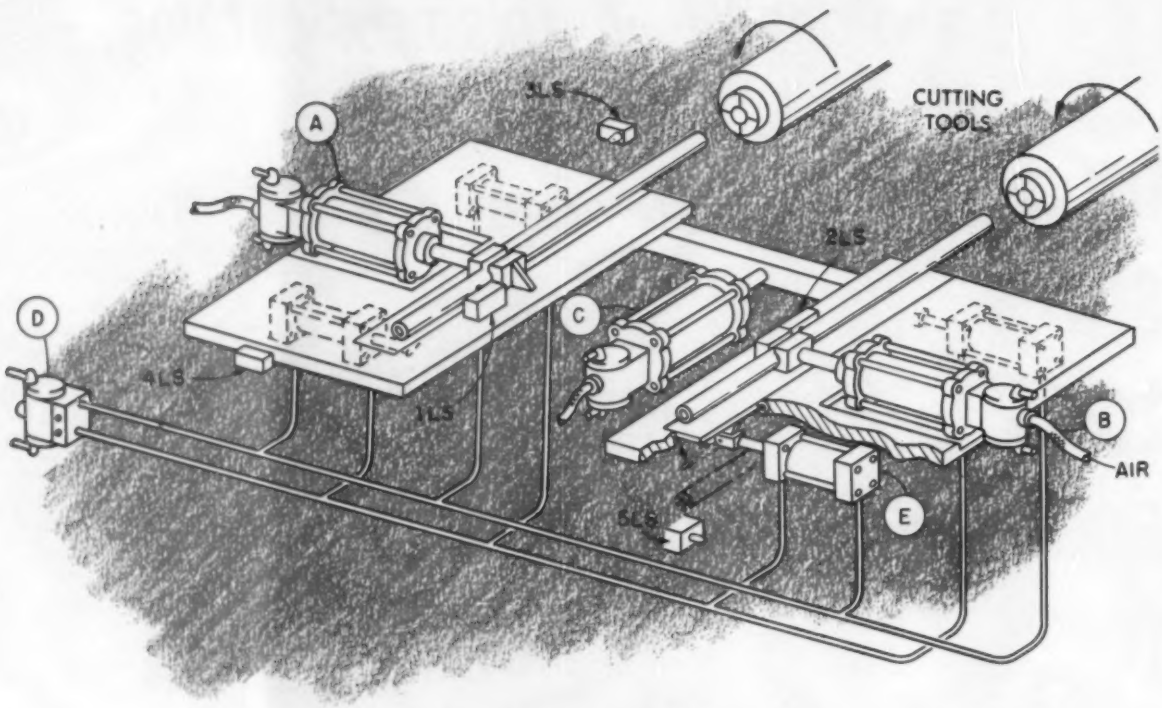
THIS SIMPLE SPOT-A-MATION IDEA CAN BE USED TO END MACHINE PIPE, TUBING, ROD OR BAR STOCK



The Spot-a-mation Idea* shown above was developed by one of the automotive companies to thread torsion bars. The operator lays the parts to be machined into position and touches a start switch. Bellows Air Motors® (A) and (B) clamp the parts. Bellows Air Motor (C) advances the work pieces to the two cutting tools. When the operation is completed, Air Motor (C) retracts, the small Han-D-Air cylinders (E) automatically retracted by Electroaire Valve (D) drop the finished parts into the bins below.

This basic idea can be used for such varied operations as forming, flaring, cut-off, drilling, threading, chamfering. It can be applied to operations in wood-working, plastics, paper board, as well as metals.

The simplicity of control available with Bellows-Valvair pneumatic devices enables them to be used in a range of applications limited only by the imagination of the tool or methods engineer. Your local Bellows-Valvair Field Engineer will be happy to work with you in applying these unique devices to specific production operations in your plant. Phone him today.

* SPOT-A-MATION IDEA 0.0-12 describes this operation in detail, gives complete wiring diagram and equipment list. For this, and other SPOT-A-MATION IDEAS, write Dept. TE-761, Bellows-Valvair, Akron 9, Ohio. No cost. No obligation.

1101-C

Bellows-Valvair

AKRON 9, OHIO

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

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Production Pointers

from GISHOLT

More cost-cutting IDEAS—
to help you

CALIFORNIA PRESS CUTS TIME 58% ON LARGE QUILL SHAFTS

JETracer . . . smart tooling simplifies complex jobs

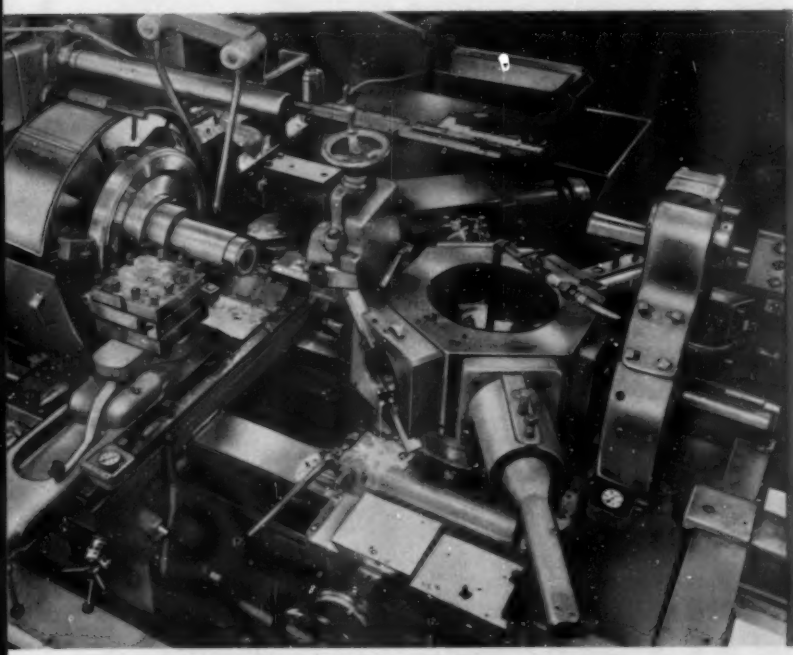
California Press Manufacturing Co., San Francisco, California, uses a Gisholt MASTERLINE® 5L Saddle Type Turret Lathe to produce a variety of large, heavy parts. Other jobs, such as large-diameter, thin-wall rings, are also machined to close tolerances without distortion. Whether your parts are large or small, their method will provide some cost-cutting answers.

Setup and machining is simplified by a JETracer on the rear of a bridge-type cross slide and a cross-feeding hex turret. Tooling costs are reduced because only standard hex turret tools (in most cases), and simple flat templates (to control the JETracer's single-point tool), are needed to provide accuracy and fine finish. Insert-type tool bits keep down-time at a minimum. Dial indicators speed positioning.

This arrangement saves 7½ hours on the quill shaft shown. Material is cast steel, SAE 4140, annealed and heat-treated to 22-25 Rc. To eliminate possible distortion, it is machined in three operations. *One* tool setup handles all *three*, with only minor tool adjustments between operations. Total f.t.f. time . . . only 5½ hours. Details are given in the photo captions.

Smart setup cuts quill shaft machining time 58%. JETracer and C/F hex turret eliminate costly form tools . . . minimize operator skill . . . improve accuracy . . . simplify inspection, for similar saving on all parts.

For information on 5L and JETracer, circle No. 756.



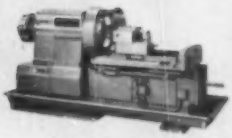
QUILL SHAFT (20¾" Diameter, 15¾" Long) MACHINED OVER-ALL IN 3 OPERATIONS WITH SETUP SHOWN AT LEFT

Operation 1—rough quill end: hex turret—rough turn quill with special holder (center of photo) and complete 11" long, 3⅛" bore; square turret—rough turn various quill diameters, face, form, undercut back of flange removing up to 1" stock. Time . . . 60 minutes f.t.f.

Operation 2—rough and finish flange end: hex turret—multiple head (far right) turns O.D., co-bores and forms . . . other stations machine various other steps in bore; square turret—finish all fit diameters, step faces, chamfers and radii. Time . . . 3 hours f.t.f.

Operation 3—finish quill end: JETracer finish traces length of quill (two passes) with center support from hex turret; square turret—undercut, groove and thread quill end using side carriage chasing attachment; hex turret—finish bore and chamfer. Time . . . 1⅛ hours f.t.f.

PREMATURE MACHINE OBSOLESENCE SOLVED



Simplimatics have flexibility for present and future needs

If you have parts that call for special or multiple-spindle machines, you'll want to study this story. The decisions reached by a major automotive manufacturer may provide some answers to your problems.

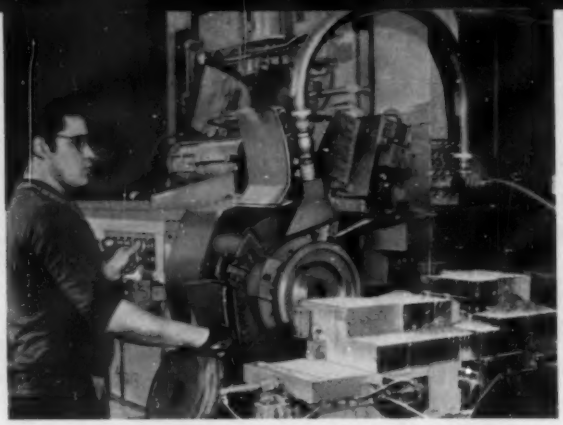
In tooling up to produce 5 different sizes of flywheels, the advantages, costs, and production rates of standard and special or multiple-spindle machines were carefully weighed. Eight *standard* Simplimatics were purchased because they met the requirements listed below at *standard* machine prices.

FLEXIBILITY . . . Each Simplimatic has a wide, screw-fed platen upon which *standard* independent slides with tool blocks can be positioned to suit the work. Two machines have a headstock-mounted auxiliary slide for machining behind the leading edge of the work. To meet varying production needs, all tool blocks for front, rear, and auxiliary slides have locating keyways and stops and are *completely interchangeable* between machines.

MINIMUM DOWN-TIME . . . Templates were supplied so that all but the boring tools could be *pre-set* in master blocks. Throw-away insert tools are used wherever possible. When a tool dulls, the operator can quickly index to a new edge or replace it with another pre-set tool, locating against ground surfaces in the tool block.

OBSOLESENCE . . . Tool blocks can be easily modified with minimum effort and cost to produce any existing or *future* part design.

PRODUCTION . . . Simplimatic completes maximum surfaces per cycle. Caption provides machining details.

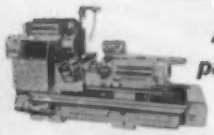


First operation on 13.250" flywheel. Table feed bores, turns O.D. from front slide . . . standard movement faces. Table feed co-bores and shaves bevel from rear slide . . . standard movement faces, chamfers and shave-turns ring gear diameter. Auxiliary slide sizes ring gear diameter. Eleven tools machine 13 surfaces at approximately 300 sfm. Time . . . only 1.30 minutes.

Simplimatics give you top production rates, peak versatility at standard machine prices. Tooling . . . not machine . . . can be modified at low cost for new work.

For information on Simplimatic, circle No. 757.

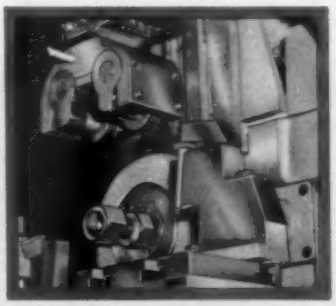
L&L COMBINES OPERATIONS FOR 60% TIME SAVINGS



AR Turret Lathes produce finished parts from bar stock—automatically

This setup shows how you can reduce costs on bar work—involving both internal and external threading, forming and cut-off operations. With it, L & L Manufacturing Company, Warren, Michigan, cut machining time on intermediate size runs an average of 60% on over 1500 different types of pipe and tube fittings, made from round, square, and hex C-1119 steel bar stock.

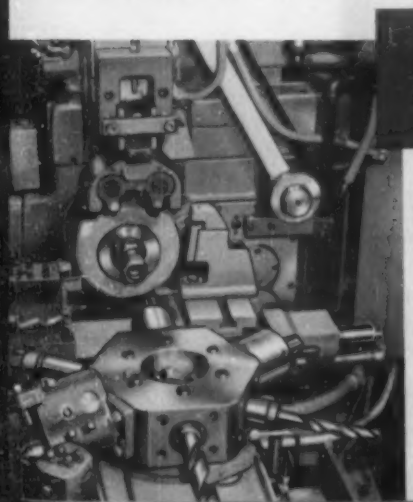
Equipment selection played an important part in obtaining these savings. Competitive machines were evaluated with these objectives in mind: Complete automatic operation; use of solid taps, self opening dies, and thread rollers during same cycle; tooling capacity to complete parts in one cycle; range and number of speeds for maximum metal removal and optimum tool life; rigidity for forming cuts; quick setup; and initial cost.

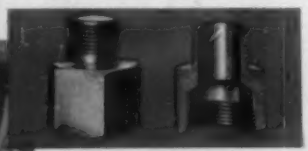


Overhead slide rolls thread behind hex shoulder. Used for cut-off operations on certain other parts.

As a result, three Gisholt 5AR Turret Lathes were purchased. One 4½" and two 2½" capacity machines were needed to handle product mix. All were equipped with an extra tool slide, mounted on the headstock, above the spindle. One 2½" machine has an octagon turret. This gave L & L a choice of 9 or 11 tooling stations so that even the most complex parts could be completed in one machining cycle.

The entire cycle, including operation of collet chuck and bar feed, is automatic and repeats until new bar stock is needed. Stock stop, drilling, reaming, tapping or O.D. threading is handled from the hex or octagon turret. The overhead slide is used to roll threads on some parts with forming and cut-off done by front and rear cross slide tools. On other parts, forming is handled by cross slide tools with cut-off from the overhead slide. A typical sequence is given in the photo caption.





Tooling for 2" pipe reducing connector (Inset) made from hex bar stock. Tapered O.D. behind shoulder is rough-formed as machined part is cut-off from front cross slide. Rear cross slide finish forms tapered O.D. holding to .001". Turret tools start-drill, radius and drill large and small bores, taper-ream and tap large bore. Overhead slide rolls thread behind shoulder. Stock advances to turret stop and cycle repeats. Time . . . 2.5 minutes f.t.f.

AR offers complete automatic cycle on bar work . . . cuts time 60%. . . combines operations. . . saves extra handling . . . improves accuracy. Operator can handle two machines.

For information on AR Turret Lathes, circle No. 758.

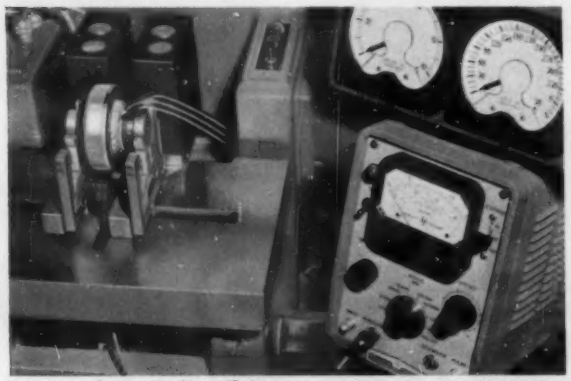
SPEED UP AND SIMPLIFY SMALL PARTS BALANCING

...New High Speed Balancer saves time, improves accuracy at low cost...

Producing small, high-speed parts or assemblies? You can now measure and correct for unbalance in parts weighing from ½ to 8 oz., or from 8 oz. to 10 lbs., rotating at any speed between 2,000 and 12,000 RPM.

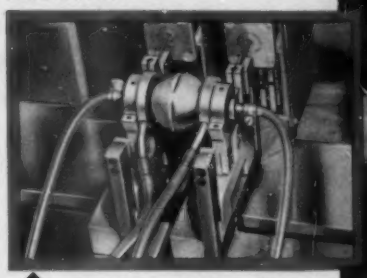
The HS-2 Balancer shown, is used for two-plane balancing of electrically self-driven gyro rotors and air-driven gimbal and gyro assemblies. It cut previous time in half and gave three times greater accuracy. Support fixtures permit quick changeover for additional time savings.

Except for method of drive, both workpieces are handled in the same manner. During each revolution, an abrupt change from dark to light finish on the work O.D. triggers a photo tube. This permits accurate speed indication on a tachometer and close regulation at 6,500 RPM for maximum accuracy. It also offers an exact reference point for locating angle of unbalance. After acceleration, angle and amount of unbalance is read in both planes in only 30 seconds. Meters eliminate all operator "guessing".



Rotation of electrically self-driven gyro rotor triggers photo tube under part to show speed on tachometer (lower right), and operate angle meter (top right).

Correction drilling of gyro rotor uses dial indicator to match depth on amount meter.



▲ Air-driven gimbal and gyro assembly. Balancing sequence, including correction and inspection, takes less than 15 minutes.

A separate correction drilling unit is used to meet the .000020 oz. inch tolerance. To correct in each plane, work is placed in a fixture and indexed until the indicated angle is under the drill. The operator refers to a dial indicator as he drills to the depth shown on the amount meter. One correction pass in each plane takes less than 4 minutes. Additional passes may be necessary if unbalance is excessive or if material is not homogeneous. Work returned to balancer for final inspection.

HS production rates depend on part—range from 1 minute on fans and wheels to 4 minutes on armatures. Includes time to accelerate, locate, measure, stop, correct, inspect.

For information on HS Balancers, circle No. 759.

LOW-COST METHOD FINISHES MULTIPLE SURFACES

Completes one to six diameters during fast automatic cycle...

If you grind bearing and seal diameters on shafts or spindles, the savings offered by Superfinish will surprise you. The finishing of tractor transmission input shafts points up some of the chief advantages.

LOW COST . . . Here, a Model 51 General Purpose Superfinisher, using inexpensive abrasive sticks, handles a variety of parts. Machine and tool cost is only a fraction of what would be required if any other method were used to meet the close tolerance, fine finish requirements of the manufacturer.

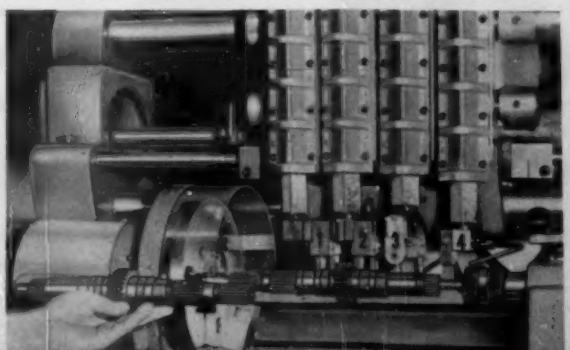
VERSATILITY . . . Extra quills can be added to complete several diameters simultaneously, with no increase in cycle time. Four quills are used on the part shown. Two off-set holders carry two stones each—the others carry one stone—so that six diameters are completed at the same time. These are reduced from 40 to 8 micro inches rms in only 50 seconds, f.t.f. Any other method would require more expensive tooling and/or several operations to do the same amount of work.

IMPROVED METALLURGY AND GEOMETRY . . . These parts are SAE 8630 steel. Specified hardness of 60-63 Rc must be maintained for reliable operation. They are rough ground to size and a 40 micro inch rms finish. Grinding heat anneals a microscopic layer on the surface. Superfinish removes this layer and exposes the true base metal. No heat is generated so hardness is unchanged. Because Superfinish is an area-contact process, roundness is improved and longer-pitch waviness is corrected. Peaks that break down and cause premature wear are removed, leaving plateaus for greater bearing area and valleys to retain lubricant.

Superfinish costs less . . . handles multiple surfaces with no increase in cycle time. Improves metallurgy and part geometry for greater product reliability.

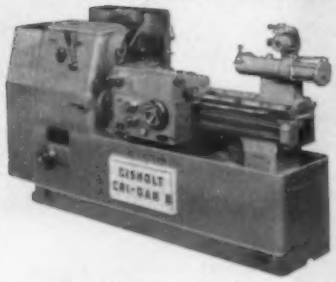
For information on Superfinish, circle No. 760.

Tractor transmission input shaft (SAE 8630 steel . . . 60-63 Rc) held between centers, driven from spline. Off-set holders 1 and 2 carry two stones each . . . finish four diameters. Holder 3 completes 1¾" long diameter. Off-set holder 4 handles one diameter. Six stones work together reducing 6 surfaces from 40 to 8 micro inches rms. Production . . . 48 parts per hour.



HOW TO BOOST PROFITS ON THREADING OPERATIONS

CRI-DAN Technique offers savings of 30% to 80% over conventional methods



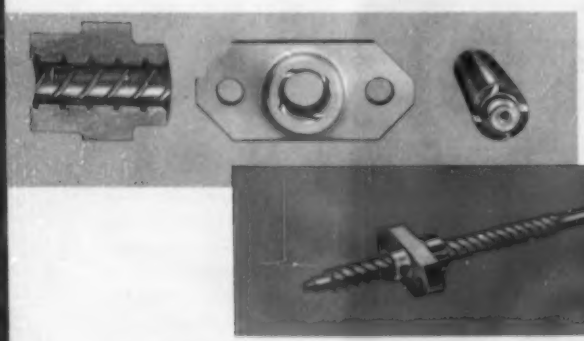
The photos on this page illustrate some of the threading operations you can do on a Gisholt Cri-Dan B Automatic Threading Lathe. Note the wide variety of work, the different threads and materials, and the fast threading times.

These jobs are simple on the Cri-Dan B—yet, each presented problems that could only be solved at high cost in equipment, tooling and time, using any other method. They prove *you* can use inexpensive, single-point carbide tools to produce simple or complex *quality* threads . . . *automatically*.

With Cri-Dan you'll have fast 15-minute setup, low tool cost, and versatility that permits combining precision threading with tracing, turning, boring or facing cuts in one automatic cycle. This means higher profits on small lots as well as long production runs.

Compare these threading times with your own, on similar work. How much could *you* save—with a Cri-Dan B?

For information on Cri-Dan B, circle No. 761.



AIRCRAFT RUDDER PEDAL ADJUSTING SCREW (SAE 4130-25-30Rc) AND NUT (Aluminum Bronze) for Lockheed Model C-130 Airplane

OPERATION

Screw: Generate ½"–10 4-start Acme Thread with 1" lead .060" deep for length of 5¾".

Nut: Generate matching 4-start internal thread.

TIME

Screw: 25 minutes f.t.f.
Nut: 15 minutes f.t.f.

SAVINGS

Screw: 65 minutes per part (previously milled).

Nut: Difference between cost of single point carbide tool and $490.00 tap for this job.

CUSTOMER

Orlando Machine Co., New Smyrna Beach, Florida.

SPOOL VALVE (440C Stainless)

OPERATION

Generate tapered 20 TPI NF Class 3 thread in .4675" bore right up to internal face.

TIME

30 seconds to thread—production 35 parts per hour.

SAVINGS

5.03 minutes per part—467% compared to tapping. Rejects eliminated (were as high as 20%), longer tool life (to 75 parts per grind).

CUSTOMER

Acme Industrial Co., Chicago, Illinois.

BEARING ADJUSTMENT NUT (cast iron)

OPERATION

Turn, chamfer front O.D., generate 12 TPI, .054" deep thread on 6⅛" O.D., face and chamfer rear O.D.

TIME

1.8 minutes f.t.f.

SAVINGS

60% on machining and threading time; replaced two machines; improved quality.

CUSTOMER

Mack Trucks, Inc., Plainfield, New Jersey.

ZOOM OPERATING SLEEVE (Aluminum); FRONT CELL LENS (Aluminum) for 8 mm. ZOOMATIC MOVIE CAMERA

OPERATION

Sleeve: Bore, generate 2-start, .0625-pitch, .125" lead, Class 4 16NS thread in 1.610" center section of bore.

Lens: Turn rear pilot diameter, generate mating threads on 1.610" leading diameter.

TIME

Sleeve: 20 seconds f.t.f.
Lens: 20 seconds f.t.f.

SAVINGS

50% time reduction — improved quality.

CUSTOMER

Bell and Howell, Chicago, Illinois.

GISHOLT

MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

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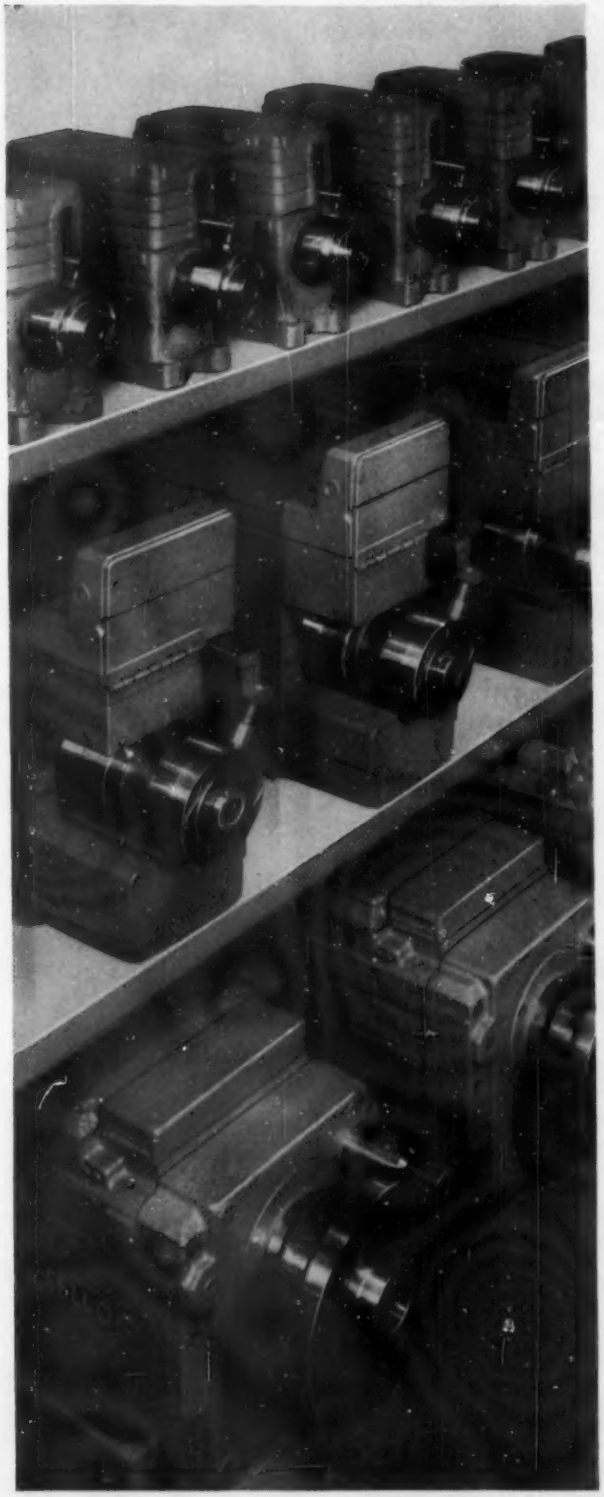


NEED Power Units in a Hurry?

Ex-Cell-O gives you off-the-shelf delivery!

In stock for immediate delivery, Ex-Cell-O Hydraulic Power Units are available in four quill-type models offering a wide range of spindle speeds, horsepower, stroke and thrust.

Self-lubricating for low maintenance, and precision-built for long life, Ex-Cell-O Hydraulic Power Units, and our Canadian-built lead-screw type Tapping Unit, are designed for drilling, reaming, tapping, spotfacing and other single or multiple operations, and for heavy-duty boring and milling machine applications. Pre-set start, rapid approach and return, dwell, reverse and stop are fully automatic.

Your Ex-Cell-O Representative has complete specifications, or write direct for our catalog. The model you need is on the shelf now—ready for same-day shipment to your plant!

61-21MA

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

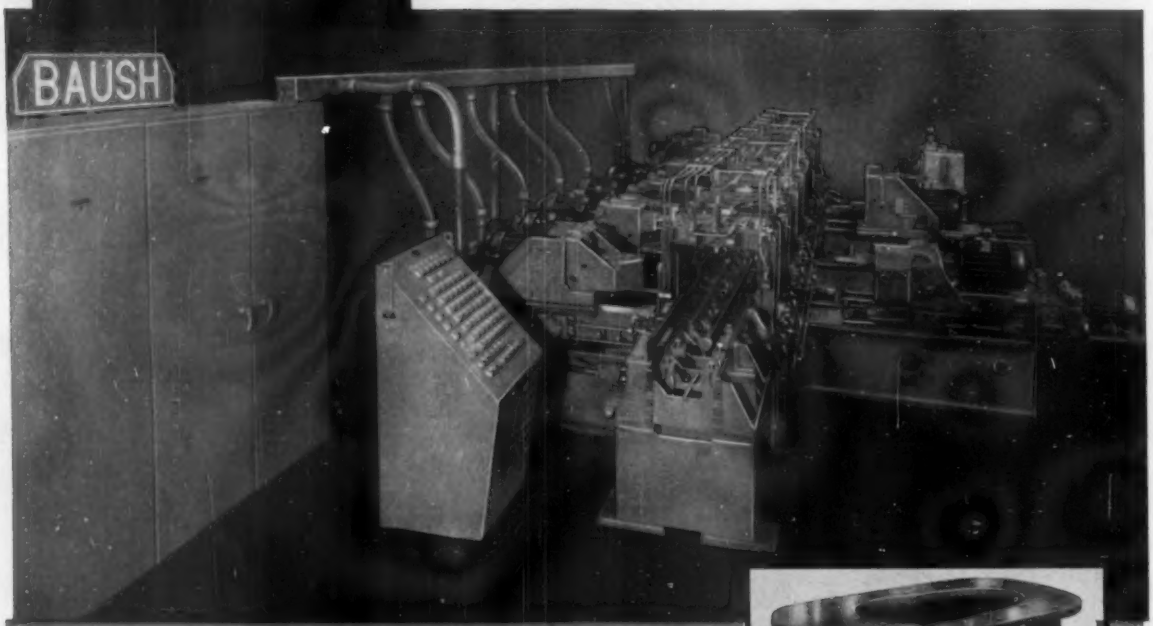
FOR USE IN GREAT BRITAIN

A 10 Station Baush Horizontal Automatic Transfer Line built for a leading British automobile manufacturer to perform operations on top and bottom of transmission case.

This 10-station horizontal transfer consists of —

- 1 Loading Station
- 7 Working Stations
- 1 Blow-off Station
- 1 Unloading Station

The transfer line is made up of 4 Horizontal Hydraulic Slide Units and 5 Horizontal Mechanical Leadscrew Units having 9 Fixed Center Heads equipped with a total of 32 spindles.



Operations performed are: Mill, Drill, Ream, Countersink, Chamfer and Tap. Individual leadscrew spindles are used for tapping and lubrication is by air-oil mist.

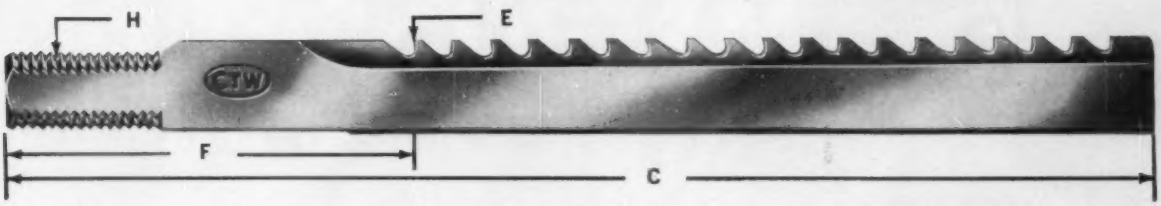
Production is 62 Transmission Cases per hour, or 1984 operations, working at 100% efficiency.

If it is rugged reliability, accuracy and economy of operation you are looking for in single purpose multi-spindle machine tools, then you want BAUSH MACHINE TOOLS.

BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS

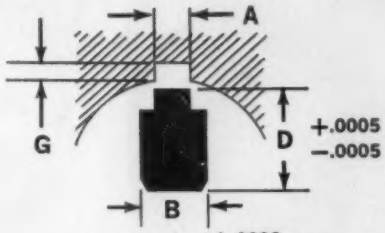
We know Baush can help — why not call us!

CTW Keyway Broaches in Stock NOW for Immediate Delivery!



Continental now stocks a popular range of standard keyway broaches to help you meet production schedules faster than ever, and to let you cut your tool inventory.

Just call your CTW Representative, or order by catalog number direct from Continental. The broaches you need are in stock now—ready for immediate delivery to your plant!



Sizes listed below are available for immediate delivery. See the CTW Catalog for other standard broaches. Special sizes quickly made to order. Send your print for a prompt quotation.

BROACHING INDUSTRY SERIES

Catalog Number	A Keyway Width			Min. Hole Size	Min.† Length Cut	Max. Length Cut	Width of Body B	Total Broach Length C	Height at Last Tooth D	Height at First Tooth E	Length of Shank F	Keyway Depth in Part G	No. of Cuts	Thread H
	Nom. Dim.	Decimal Dim.	Tolerance											
502	3/32	.0948	±.0002	7/16	1/2	1 1/2	.1865	24	.367	.309	8 1/4	.058	1	5/16-18
504	1/8	.126	±.0002	1/2	1/2	1 1/2	.249	30	.438	.364	9	.074	1	1/2-16
505	1/8	.126	±.0002	11/16	5/8	2 1/2	.3115	36	.594	.520	10	.074	1	1/2-13
508	5/16	.1885	±.0002	11/16	5/8	2 1/2	.374	36	.581	.476	10	.105	1	1/2-13
512	1/4	.251	±.0002	11/16	5/8	2 1/2	.374	36	.612	.476	10	.136	1	1/2-13
513	1/4	.251	±.0002	1	11/16	4	.499	45	.877	.741	11 13/16	.136	1	5/8-11
514	1/4	.251	±.0002	1 1/16	7/8	6	.624	51	1.250	1.114	13 1/2	.136	1	3/4-10
517	5/16	.314	±.0002	1	11/16	4	.499	45	.908	.741	11 13/16	.167	1	5/8-11
519	3/8	.3765	±.0002	1 1/16	11/16	4	.499	45	.938	.739	11 13/16	.199	1	5/8-11
520	3/8	.3765	±.0002	1 1/16	7/8	6	.499	54	1.189	.990	13 1/2	.199	1	5/8-11
523	1/2	.5015	±.0002	1 1/2	11/16	4	.624	48	1.312	1.051	12	.261	1	3/4-10
524	1/2	.5015	±.0002	1 1/2	1	8	.624	48	1.377	1.246	16 1/2	.261	2	3/4-10
ORIGINAL CTW SERIES														
CTW 7	3/16	.1885	±.0002	11/16	1/2	2 1/2	.375	36	.581	.480	9	.101	1	1/2-13
CTW 10	1/4	.251	±.0002	11/16	5/8	2 1/2	.375	38	.612	.480	9	.132	1	1/2-13
CTW 11	1/4	.251	±.0002	1	11/16	3 1/2	.500	44	.877	.740	10	.137	1	5/8-11
CTW 14	5/16	.3135	±.0002	1	11/16	4	.500	46	.908	.740	10 1/2	.168	1	5/8-11
CTW 17	3/8	.376	±.0002	1 1/16	11/16	4	.500	46	.938	.740	10 1/2	.198	1	5/8-11
CTW 23	1/2	.501	±.0002	1 1/2	11/16	3 1/2	.625	46	1.422	1.160	10	.262	1	3/4-11
ORIGINAL XLO SERIES														
XLO 3	3/16	.1885	±.0002	13/32	13/32	1 1/4	.250	28	.541	.438	8 1/4	.103	1	5/8-16
XLO 5	5/16	.1885	±.0002	5/8	5/8	2	.375	28	.541	.438	8 1/2	.103	1	1/2-13

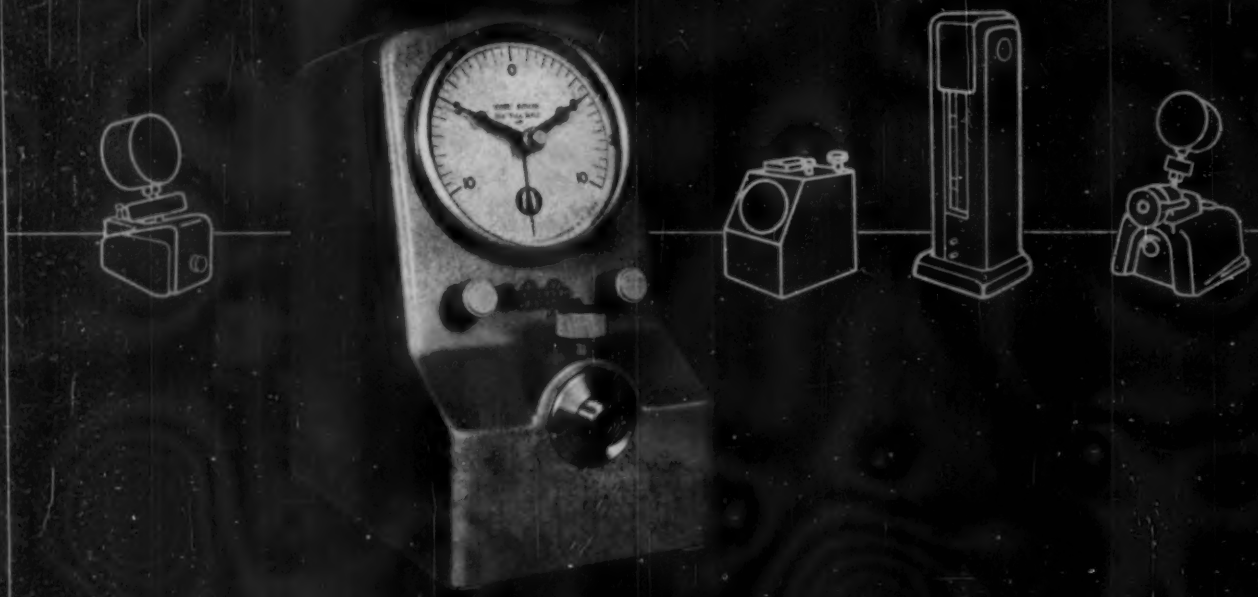
†MINIMUM LENGTH OF CUT RECOMMENDED TO PREVENT PART FROM DROPPING BETWEEN TEETH OF BROACH

61-33C

Continental CTW TOOL WORKS DIVISION OF EX-CELL-O CORPORATION DETROIT 32, MICHIGAN

ADJUSTABLE MAGNIFICATION

30 DAY FREE TRIAL



STANDARD'S AIR GAGES CAN REDUCE YOUR GAGING COSTS —

PROVE IT YOURSELF IN YOUR OWN SHOP

COMPARE IT FOR

- ACCURACY
- VERSATILITY
- MAINTENANCE
- EASY SET-UP
- DIAL SIZE
- PRICE VS. COST

ASK YOUR MAN FROM STANDARD OR WRITE TO:

STANDARD GAGE COMPANY, INC.

MANUFACTURERS OF MECHANICAL & AIR GAGING EQUIPMENT

POUGHKEEPSIE, N. Y. TELEPHONE GROVER 1-3100

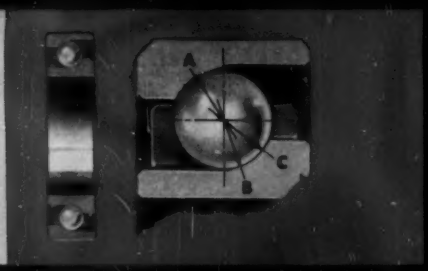
EX-CELL-O SPINDLES

RUN TRUE

1

2

3



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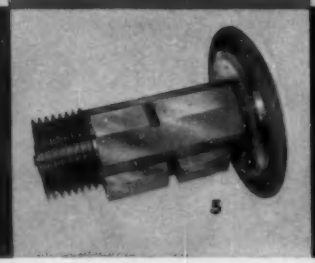

5

1. High-frequency, 25,000 rpm motorized type.
2. Cutter grinder model; 3600 rpm inbuilt motor.
3. Vertical units fit many power requirements.
4. I.D. type adapts to most machines.
5. Form grinder spindle; 25 h.p. capacity.

Cross-section drawing (above right) of single-row bearing shows points of ball contact (A, B and C) on tracks in race.

59-27

EXCLUSIVE RADIAL THRUST BEARING DESIGN PUTS PRECISION INTO PRODUCTION GRINDING

What makes Ex-Cell-O Precision Grinding Spindles run true? Engineering experience, skill in precision production and assembly, quality materials—and perhaps most important, the famous Ex-Cell-O Precision Spindle Bearing!

Made by Ex-Cell-O for use only in Ex-Cell-O Spindles, this custom-made bearing is the product of a unique Ex-Cell-O process which develops tracks or pathways in the race. The ball contacts the race only at these narrow, mirror-smooth bands (see detail above).

As a result, the bearing runs cooler at high speeds; wear is reduced, rigidity is improved, and spindle accuracy is measurably increased.

In widespread original equipment use, Ex-Cell-O Spindles are also an economical means of increasing speed and accuracy in older I.D. or O.D. surface and thread grinders, tool and gear grinders and similar equipment.

See your Ex-Cell-O Representative, or write direct for details on the complete line of Ex-Cell-O Precision Grinding and Boring Spindles.

EX-CELL-O FOR PRECISION

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

XLO Machinery Division

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Use Reader Service Card, CIRCLE 24

Use Reader Service Card, CIRCLE 25

WHY RISK LOSS OF GEAR SHAPER PERFORMANCE?

Give your products all the high-production, high precision advantages of Fellows Gear Shaper performance by tooling up with Fellows cutters.

The better design of Fellows cutters is the result of advanced engineering techniques, including the use of a high-speed computer for solving design and application problems. Their better quality is the result of constant advances in metallurgy and manufacturing methods. And, proof of their better performance are the thousands of Fellows cutters in use on modern gear production lines.

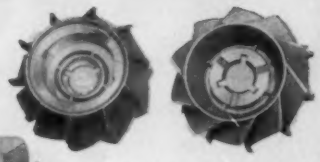
Fellows cutters on Fellows machines lower costs and speed production on external and internal, spur and helical involute gears and a wide variety of non-involute shapes as well. All Fellows Offices are at your service for providing information.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont, U.S.A.
Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE PRECISION LINE **Fellows** *Gear Production Equipment*

Let the work size, operations, finish or output change . . .

Standard Ex-Cell-Os will meet your needs!



Double-end Model 752 (shown at left) finish-machines both sides of this torque converter stator in one cycle at a rate of 140 per hour. Standard tooling, spindles, and other components permit fast change-over from this job's boring, turning, facing, grooving and chamfering operations to any required single or multiple functions.

Close center-distances are held on this transmission pump cover, one of three different parts finished on a single-end Model 751 Precision Bore. Cross slide indexes during each cycle, and a common spindle bores the dowel holes. One or more Heavy Duty or Ultra-Precision Spindles can be used in place of the three Ex-Cell-O Square Body Spindles shown.

Modern Ex-Cell-Os represent over 30 years of specialization in Precision Boring Machines. Your Ex-Cell-O Representative has data on a wide variety of standard, special and building-block types to quickly provide optimum equipment utilization in your plant. Call him soon, or write direct for details.

61-16M

EX-CELL-O FOR PRECISION

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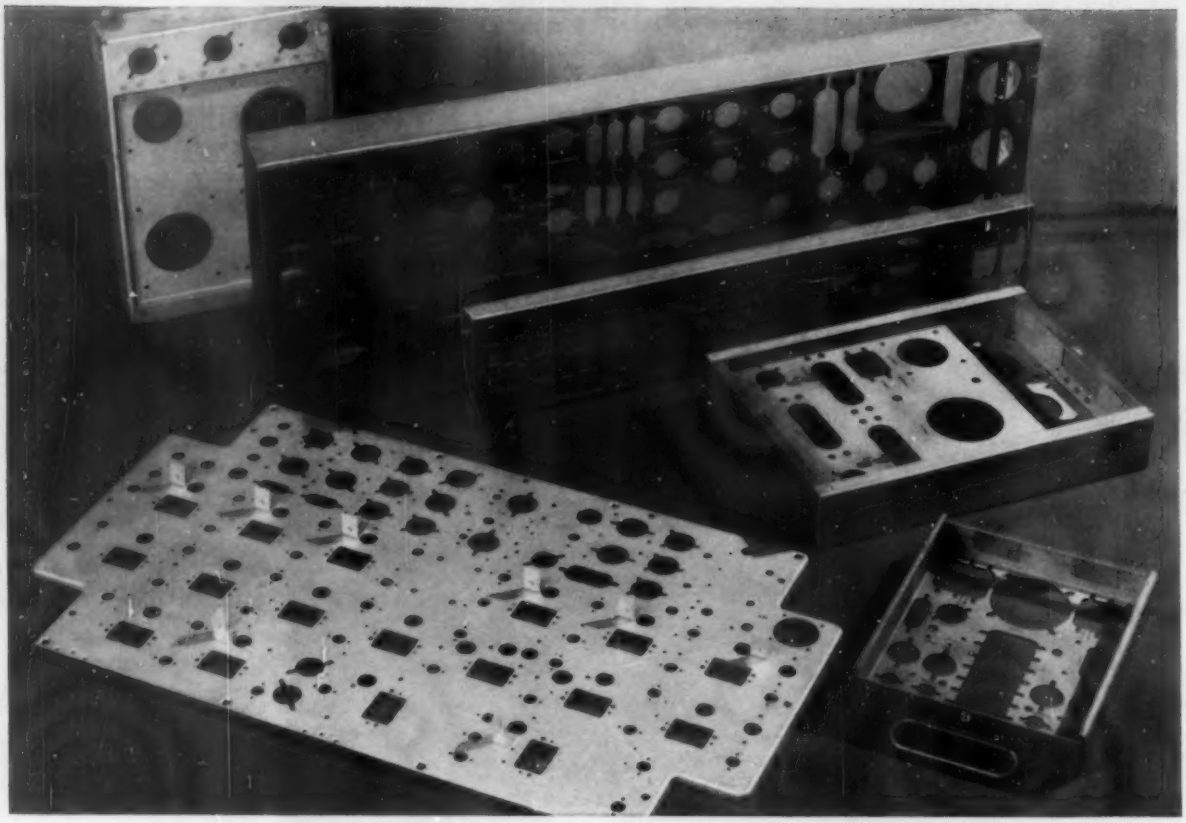
Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN



PUNCH COMPLICATED PATTERNS FAST

With the new improved STRIPPIT 15-A Fabricator, complicated patterns of round and shaped holes can be produced quickly and accurately in sheet material. A high speed punch press that enables you to produce finished pieces directly from drawings, the versatile STRIPPIT 15-A eliminates slow "in-between" tool designing and die making... saves you days or even weeks of valuable time.

The STRIPPIT 15-A features a unique multiple-stop gauging system for positioning work to exact layout specifications. Punches and dies... within easy reach in built-in file drawers...can be switched from one size to another in less than 20 seconds. Designed especially for prototype and short production runs, the STRIPPIT 15-A is easily converted to a high speed production punching unit with the STRIPPIT Duplicator.

The STRIPPIT 15-A:

- **PUNCHES** any round or shaped hole up to 3½″ diameter. Maximum material thickness is ¼″.
- **NOTCHES** 90° corners—rectangular, radii, vee and special shape edge notches—up to ⅛″ capacity in mild steel.
- **NIBBLES** straight line or contour shearing up to 38″ diameter circle, at 165 strokes a minute, ½″ mild steel.

Send now for 15-A catalog. Free demonstration can be arranged right in your plant.

WALES **STRIPPIT** INC.

A UNIT OF HOUDAILLE INDUSTRIES, INC.

211 Buell Road • Akron, New York

In Canada: Strippit Tool & Machine Company, Brampton, Ontario
In Continental Europe: Raskin, S.A., Lausanne, Switzerland *In the British Isles: E. H. Jones (Machine Tools) Ltd., Hove, Sussex, England*

There's a Full Tool Steel Warehouse
Behind the A-L STEELECTOR Cards!

The pocket-size STEELECTOR Cards represent a full tool steel warehouse—full of the grades and shapes and sizes.

Each STEELECTOR Card (there are cards for hot work, high speed, and tool room applications) uses bar graphs to show how the STEELECTOR grades compare in abrasion resistance, toughness, size stability, machinability, and red hardness. In a glance you can select the grade with the best combination of properties for virtually any job.

And when you select a STEELECTOR steel, you know beforehand that it is quickly available. Warehouse supplies have been increased because of the widespread usefulness of STEELECTOR grades.

A Data Stock List for each STEELECTOR grade gives you additional information—to help you make sure that the steel fits your job exactly. The steel's properties are described and the proper hardening, tempering, and annealing temperatures are given along with the steel's analysis and AISI number. A list of typical applications together with suggested working hardnesses serves as an additional check on your use of the steel.

The Data Stock List also tells exactly what sizes and shapes are in warehouse stock. You know before you order that the tool steel you choose is ready for prompt delivery.

By using STEELECTOR grades, you can save storage space in your own plant. You can reduce the number of grades you stock. And you can rely on fast off-the-shelf delivery in case your own stock runs low.

For more information on the STEELECTOR system, ask your Allegheny Ludlum representative for your copy of the colorful, 10-page STEELECTOR Booklet, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.*** Address Dept. TE-7-2. 3240

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country

is someone in your plant

SAVING PENNIES AND BURNING DOLLARS?

"A penny saved (may be) a penny earned." But, this is not true if the saving process destroys the effectiveness of major capital investments or causes additional expenditures in other areas.

Costs may be reduced by changing the types of milling blades and cutters being used. But, the change should be analyzed thoroughly in order not to impair a machine's capability or add other recurring expenses which, in total, will more than offset the lesser savings.

Ingersoll can help you determine which blades and cutters will give you maximum performance at minimum costs.

Because Ingersoll makes all types of inserted blade milling cutters, you can get a completely impartial evaluation.

In addition to Ingersoll's blade and cutter testing equipment, the entire Ingersoll machine building facilities are a proving ground for all types and kinds of cutting tools. Working with people in your plant, Ingersoll's sales-engineers will apply the unparalleled, diversified experience gained through these facilities.

Ingersoll's modern versatile tool manufacturing plant.

Don't let anyone in your plant start the process of saving pennies and burning dollars as far as cutting tools are concerned. Let an Ingersoll sales-engineer tell you about the Ingersoll Cutter Service and the new Blade Back-up Program. Write: **The Ingersoll Milling Machine Company, Cutter Division, 505 Fulton Avenue, Rockford, Illinois.**

"I Know Every Tool Steel Grade and Size in Warehouse Stock"

Thanks to the Allegheny Ludlum STEELECTOR

"We simplified tool steel selection immensely when we started using the A-L STEELECTOR System. It slashed our selection time to seconds. And our local warehouse always has the grade and size we need in stock—ready for immediate delivery.

"Here's how we use the STEELECTOR System: We check bar graphs of the STEELECTOR Card for the job at hand (there are cards for hot work, high speed, and tool room grades) to compare the abrasion resistance, toughness, size stability, machinability, and red hardness of the STEELECTOR grades. In seconds we can pick the best combination of properties.

"We confirm our selection with the STEELECTOR Data Stock List. (There is a List for each STEELECTOR grade.) The Data Stock List itemizes every size and shape in stock. It tells us before we order that the particular grade and size we need is ready for immediate delivery. The STEELECTOR System and quick warehouse delivery have enabled us to reduce our own inventory.

"The Data Stock Lists also tell us proper hardening, tempering, and annealing temperatures. The steel analysis and AISI number are listed along with a description of the steel's properties. And a list of suggested working hardnesses for typical applications serves as a check on our use of the grade."

The STEELECTOR System is remarkably easy to use. If you haven't investigated it yet, ask your A-L representative for your copy of the colorful, 10-page STEELECTOR Booklet, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.*** Address Dept. TE-7-3. 8841

STEELECTOR PROGRAM

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country

Atrax

Precision Ground

SOLID CARBIDE TOOLS AND BURS

Job Applications

THERE IS AN ATRAX SOLID CARBIDE END MILL ENGINEERED FOR SUPERIOR CUTTING PERFORMANCE ON ANY MATERIAL!

RECOMMENDED APPLICATIONS ATRAX "STANDARD" SOLID CARBIDE END MILLS

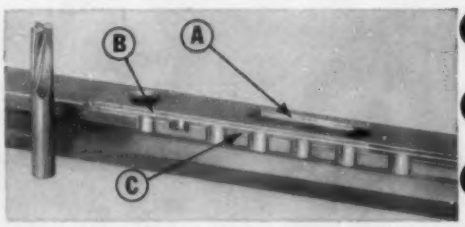
202 different "standard" Atrax Solid Carbide End Mills in 20 different series, each engineered for a specific cutting application and recommended for specific materials.

The most widely used Atrax End Mills and the materials on which they are engineered to perform best are shown in this table:

Material	Series 1501	Series 1502	Series 1503	Series 1504	Series 1505
Carbon Steels					X
Free Cutting Steels					X
Nickel					X
Nickel Chrome					X
Stainless Steels					X
Cast Iron		X	X		
Malleable Iron		X	X		X
Brass and Bronze	X				
Aluminum	X			X	
Zinc Alloy	X				
Copper	X				
Hard Rubber	X				
Fibre	X				
Plastics	X				
Monel Metal					X
Toughened & Heat Treated Steel					X
Hardened Steels					X
Titanium					X
Magnesium	X			X	

X—Preferences

TYPICAL SERIES 1505 PERFORMANCE ON ROCKWELL C-64 HARDENED TOOL STEEL WORKPIECE



A Elongating ⅜" slot, 1/16" deep at 700 rpm.

B Step cutting 3/16" wide–3/32" deep at 1150 rpm.

C Counter boring at 1150 rpm.

Note high surface finish and absence of burs and scoring. This Atrax ⅜" 1505 End Mill showed no appreciable wear land after completing three operations on this hard-to-cut material.

Note efficient, uniform chips with no burning and no chatter.

AN END MILL FOR EVERY APPLICATION

There is an Atrax "Standard" Solid Carbide End Mill job engineered for virtually every End Milling application. The Atrax Catalog gives engineering data on speeds, feeds, use of coolants and job hints that will further increase tool life production when you specify and use these superior Atrax Tools.

Send for your copy of the 148 page Atrax Catalog

THE ATRAX COMPANY

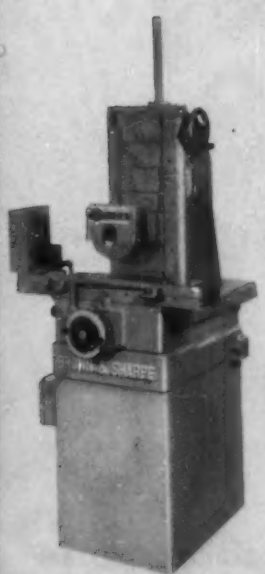
240 DAY STREET, NEWINGTON 11, CONNECTICUT

Now there are

6

Brown & Sharpe MICROMASTER

Surface Grinding Machines



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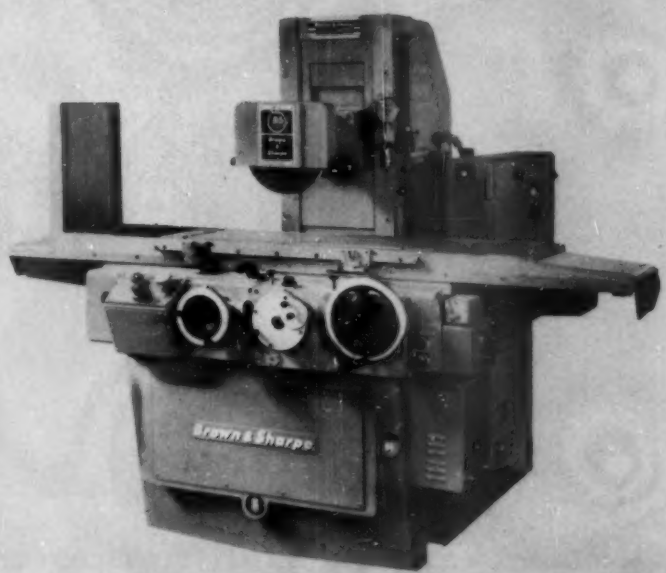

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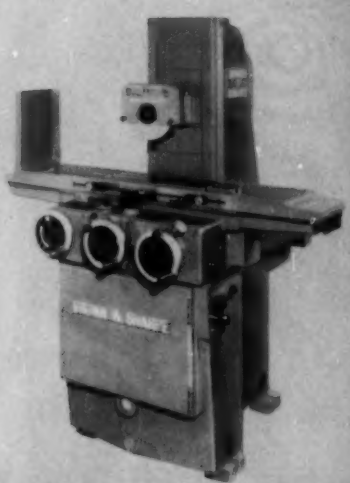


618

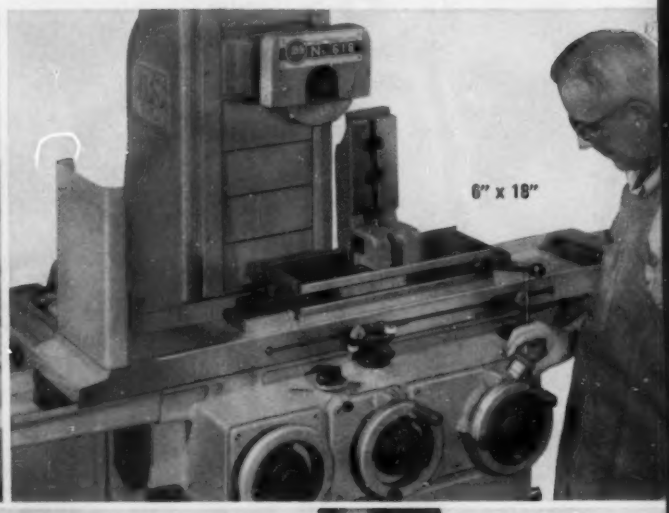
to help you make more for less...

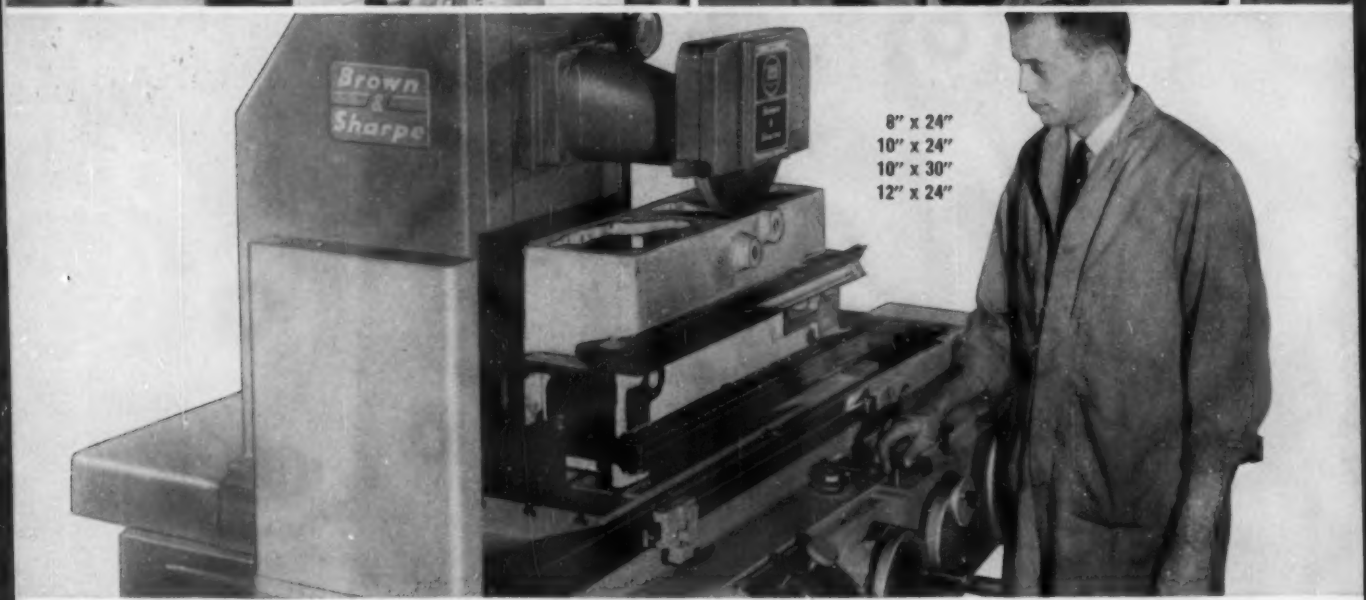
Brown & Sharpe

PRECISION CENTER

MMT-PE

TO HELP YOU GRIND MORE FOR LESS





Six MICROMASTERS - in over 100 different combinations for profit-saving in any surface grinding work range

What are your special needs in a Surface Grinder? The new series of B&S MICROMASTERS permits you to select from 6 machine sizes and specify exactly the combination you want. You get — *and pay for* — no more capacity and features than you need.

Every MICROMASTER offers you all the benefits of Brown & Sharpe long-time leadership in surface grinder design. You get accuracies to tenths of thousandths, and fine micro-inch finishes. Simplified controls speed set-ups and reduce operator fatigue. Unit-type component design and automatic lubrication assure maintenance economy.

Get complete information, and you'll agree that MICROMASTER means "the most — in profit-saving advantages — for the money." Write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

Ask about 510, the popular hand feed MICROMASTER for tool and die shops, and other smaller work . . . the **618** MICROMASTER, with hydraulic and hand feeds, that sets cost-reduction standards for toolroom or production runs in the intermediate work range . . . the **824, 1024, 1030,** and **1224** hydraulic models that provide MICROMASTER super-precision and profit-saving efficiency for larger work and production runs.

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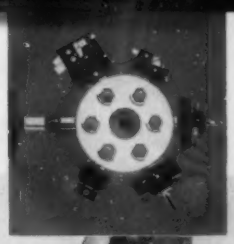
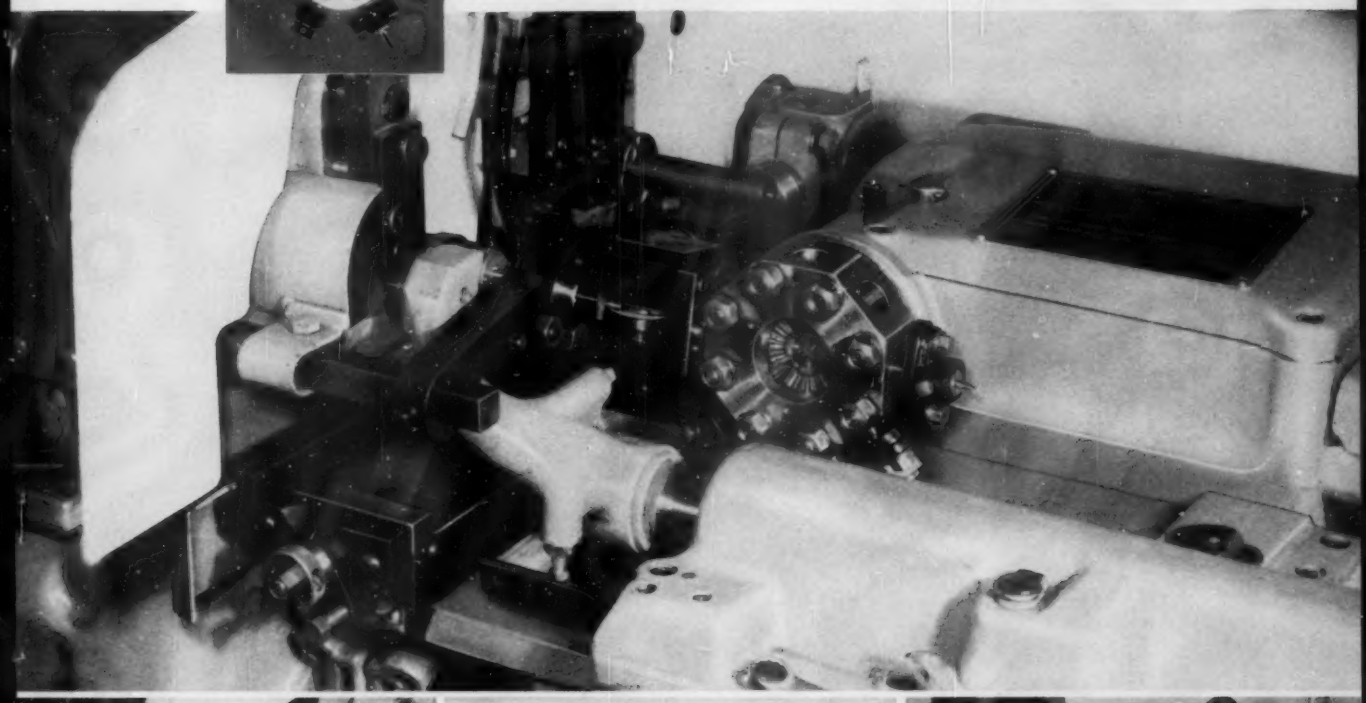
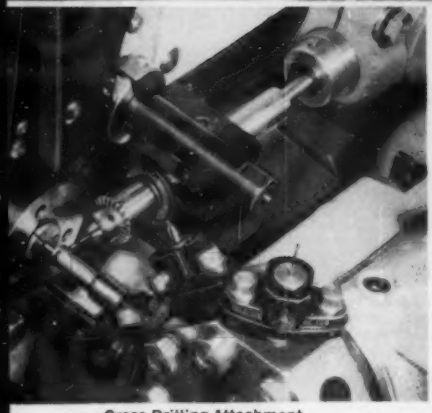
MMT-PE



ASK ABOUT THE $500 TRADE-IN ALLOWANCE ON OLD B&S AUTOMATIC SCREW MACHINES

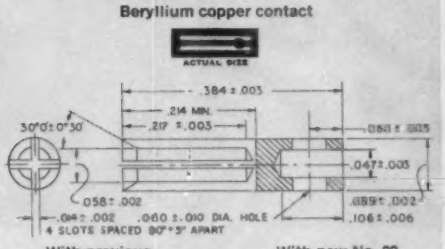




Cross Drilling Attachment

50% SAVING in production time

Beryllium copper contact



With previous equipment **70*** sec. per piece With new No. 00 Automatic **35**

*Includes time for 2 secondary operations now eliminated.

Turret Milling Attachments

Beryllium copper part, with 10 machined surfaces, completed in 35 seconds on B&S No. 00 Automatic

Ten operations are required to machine the ⅛" dia. contact shown from tough beryllium copper bar stock. Unusual drilling, milling, and reaming cuts are made to tolerances of ±.001". The strict specifications also require a smooth, burr-free finish on all 10 machined surfaces.

The part is produced complete in 35 seconds on a Brown & Sharpe No. 00 Automatic equipped with an 8-hole turret and four standard Attachments. Two secondary operations formerly required are eliminated. Net production has been increased 100%. Besides cutting production time in half, other benefits are dependable piece to piece uniformity, longer tool life, and virtual elimination of burring.

This profit-saving performance is a typical example of the new design No. 00 Automatic's adaptability. On more and more jobs, it delivers production cost savings as high as 90%. Figure the daily dollar-savings you can make with the new-design B&S Automatics, and you'll see why you can write off the investment in record time.

B&S Screw Machine specialists will survey your operations at your request, and recommend new set-ups for savings. For complete information, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

Four standard B&S Attachments are used to eliminate secondary operations. The Cross Drilling Attachment (left) permits drilling cross hole during the 35-second machining cycle. The slots are milled with two Turret Milling Attachments (right). A Rear End Drilling and Burring Attachment is also used to drill the hole at the cut-off end.

Brown & Sharpe 1833 PRECISION CENTER

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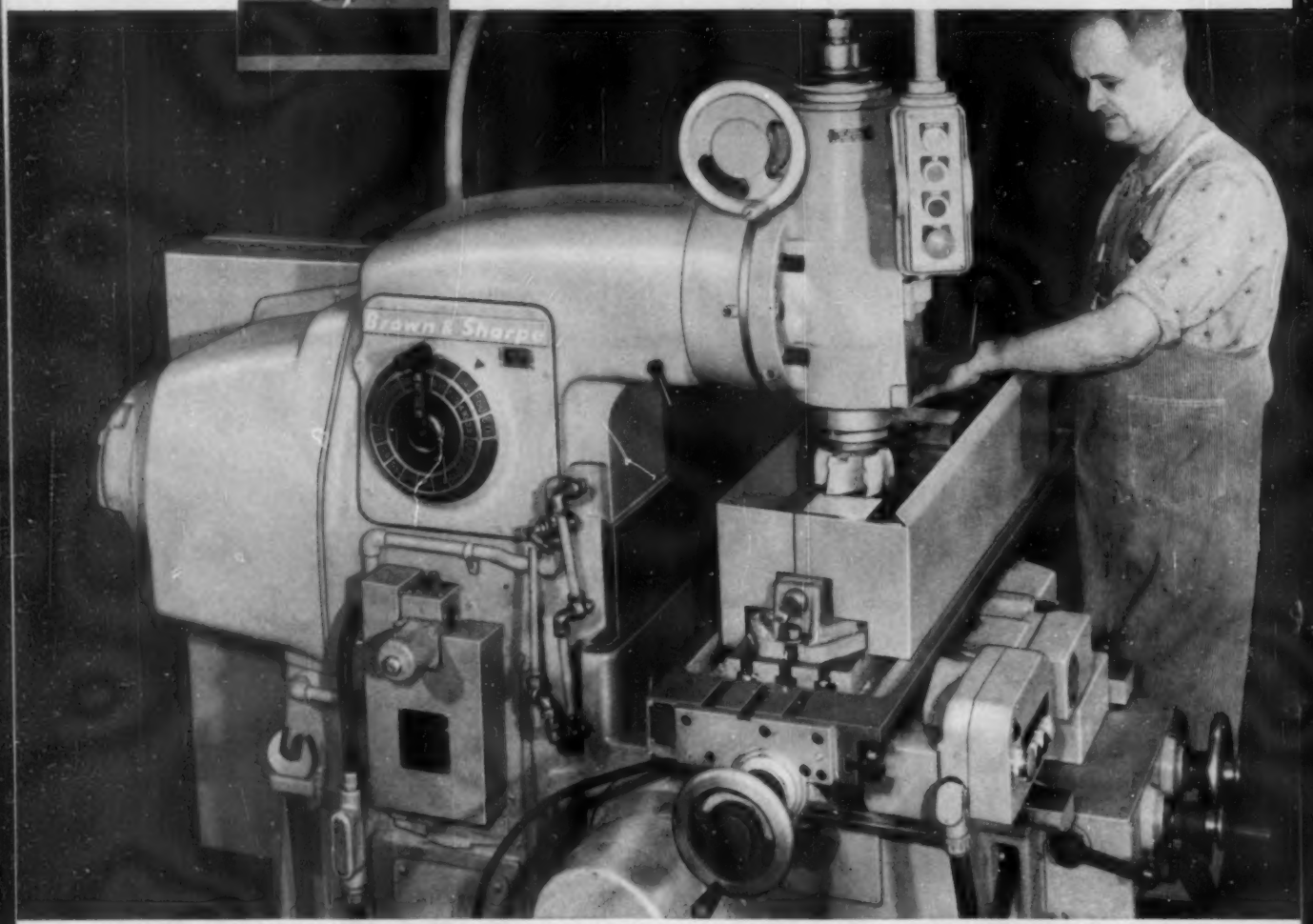
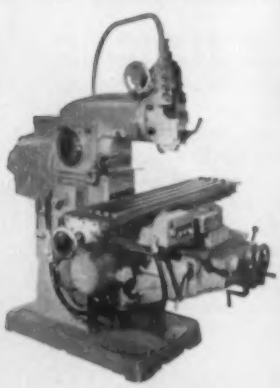
MMT·PE

TO HELP YOU MILL MORE FOR LESS



THE AUTOMATIC MILLING CYCLE is established by setting the table dogs. Operations are completely automatic. Operator simply loads and unloads fixtures. Rise-and-Fall Knee Positioning Arrangement drops the table .020" during fast return for cutter clearance. It may also be set to raise table .020" and permit finishing cut during return. Dual 10/5 hp spindle drive provides 10 hp (80 RPM to 2400 RPM) when needed for operations such as carbide milling. A simple selector switch converts to 5 hp (30 RPM to 1200 RPM). The High Feed Range permits feeds of ½" to 64" per minute.

DYNAMASTER Vertical, with standard arrangements, provides automatic carbide milling up to 2400 RPM



The "building block" construction of the new Brown & Sharpe DYNAMASTER Milling Machines permits you to order any combination of features needed. You get a standard machine with the standard optional mechanisms built-in, and avoid high cost of special modifications.

The No. 2 DYNAMASTER Vertical Milling combination illustrated includes dual 10/5 hp spindle drive, Automatic Cycle Arrangement, Rise-and-Fall Knee Positioning Arrangement, and High Feed Range. It provides the fast production potential of automatic twin-fixture milling at high carbide cutter speeds. With manual control, it easily handles all your conventional vertical milling jobs.

Before you buy milling machines for production, for toolroom, for experimental work, or for maintenance, get the complete story of the many advantages available only in the new DYNAMASTERS. No. 2 Universal, Plain, and Vertical — 3, 5, 7.5 and dual 10/5 hp — and the 3 hp Rangemaster — 132 cost-saving combinations. Write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

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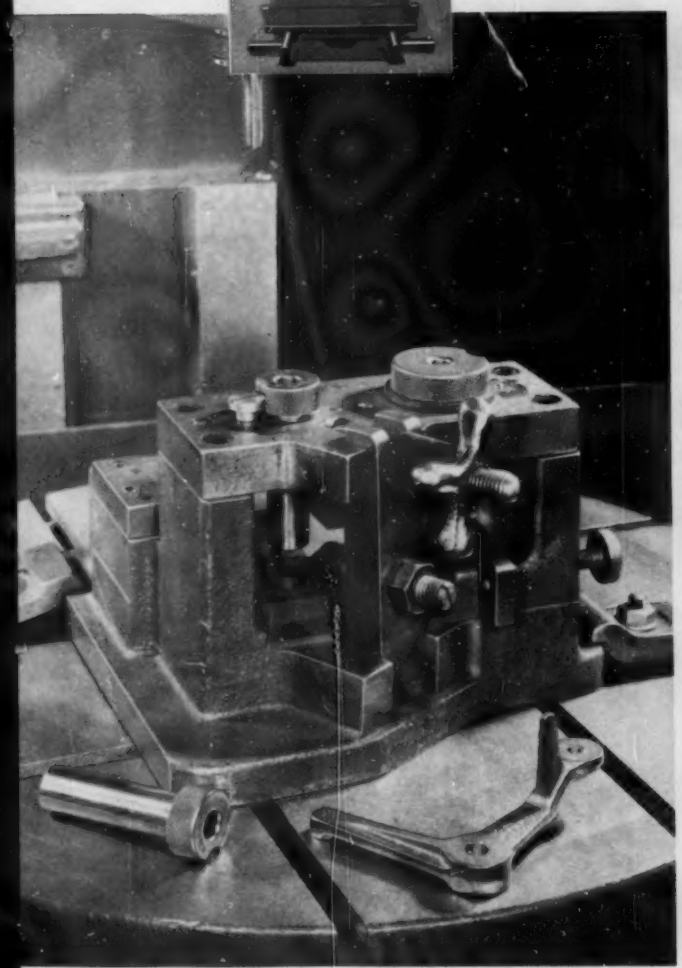
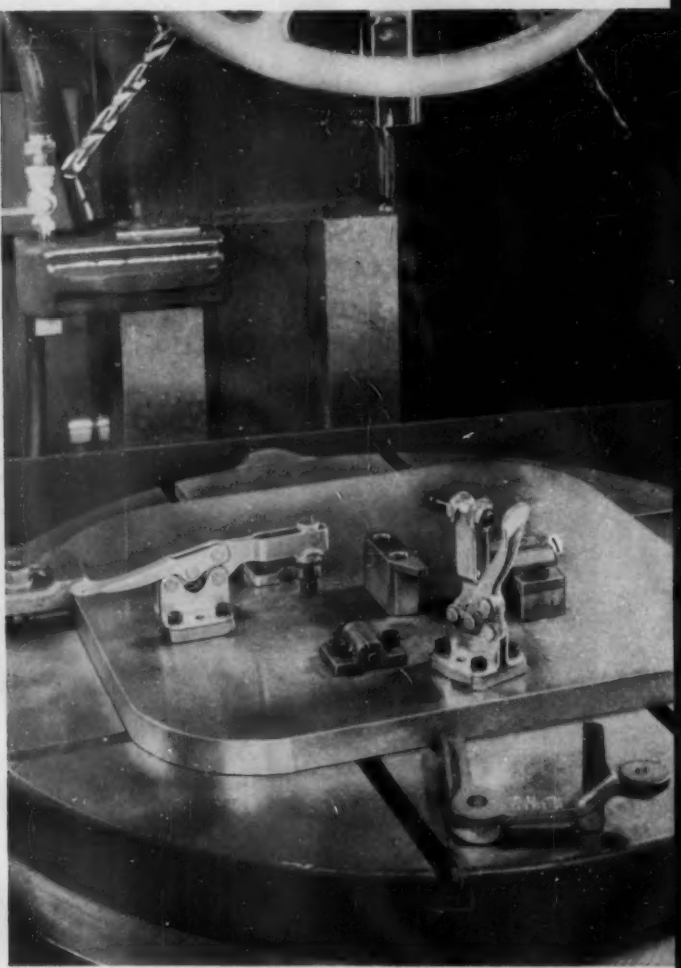
MMT-PE

TO HELP YOU DRILL AND TAP MORE FOR LESS



BEFORE — This complex jig was designed for use on a gang type drill press, then adapted to a B&S Turret Drilling Machine. Loading and cleaning is difficult and slow. Six operations are performed in 3 holes. Slip bushings are provided for some operations: others have to be done separately outside the fixture, since locations cannot be reached through the fixed bushings.

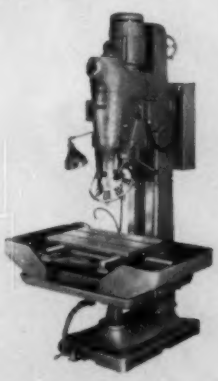


AFTER — This simple fixture holds the same part while all six required operations are quickly performed. The Positioning Table provides hole locating accuracy well within required tolerances: no bushings are needed in the fixture. The open design makes loading and cleaning easy. There is nothing to obstruct tool or table movement.

B & S Turret Drilling, with B & S Work-Positioning Table, eliminates complex fixture cost - speeds production

Brown & Sharpe Turret Drilling permits multiple drilling operations at a single station — and fast, accurate hole location without expensive jigs. These and other advantages can reduce your production drilling costs up to 80% or more. For *maximum* savings, it is essential to design tooling to take full advantage of all the benefits of the Turret Drilling method. The two fixtures illustrated are both designed to hold the same cast iron lever while it is machined on a B&S Model A Turret Drilling Machine. This comparison dramatically demonstrates how properly designed holding fixtures can eliminate complex, expensive jigs. Only a few hours are needed for design and construction of the simplified fixture. Costs of production, as well as tooling, are drastically reduced.

Find out how much you can save with Brown & Sharpe Turret Drilling Machines and Positioning Tables — in work transfer and set-up time, in tooling costs, in tool wear and maintenance — in capital investment and floor space. Write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.



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INSPECTION PROJECTOR MAGNIFIES FOR ® QUALITY...

Our inspection projector magnifies cutting edges to eliminate the minute angular deflection that could cause you costly production losses . . . just one of many inspections that account for Circle R quality.

CIRCLE R saws, slitters and combination center drills must submit to constant exhaustive inspection to work their way to you. They've got to prove they can ensure you correct cutting angles, long service, and minimal downtime.

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PHILADELPHIA
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with THE BRUSH SURFINDICATOR "meeting specs" is just part of the pay-off...

An Ohio missile-parts maker* knows why. His Surfindicator not only eliminates surface rejects but also cuts machine downtime 60%. Quick, accurate tool checks . . . at his machines . . . insure optimum tool changes to greatly extend productive tool life. *Anyone, anywhere* can measure *any* finish from 1 to 1000 microinches with a compact, portable Surfindicator. Choose the standard model or the ultimate in portability, the new battery powered, completely self-contained, 5½ lb. MS-1000. Ask your nearest Brush distributor for a demonstration. *Write for our new booklet . . . 16 pages on how Surfindicator improves profits in five major operating areas . . . production, tooling, engineering, quality control and research.* *name on request

brush INSTRUMENTS
DIVISION OF CLEVITE CORPORATION
37TH AND PERKINS CLEVELAND 14, OHIO

Value Analysis Fact Sheet

ANACONDA FREE-CUTTING BRASS ROD

Not the plain old work horse many think, it can be produced with a variety of valuable properties—in addition to high machinability—to do many special jobs better, and at lower cost.

For the great majority of high-speed screw machine jobs, free-cutting brass rod is a standard shelf item.

But in an increasing number of jobs, the free-cutting property alone is not enough. Deep drilling to close tolerances, roll-threading, knurling, staking, slotting, etc., call for uniformity in a variety of other property combinations.

Fortunately free-cutting brass is a unique "on the fence" alloy (see Metallurgical Comment at the right) that can be adapted to answer these new demands—help screw machine operators meet increasingly rigid requirements and utilize cost-saving practices.

Specialized applications. Over the past several years, Anaconda American Brass has introduced several refinements into the usual mill practice for free-cutting brass and has developed different rods for specialized applications. In most instances, these rods will still meet ASTM and Government specifications.

Chip breaking. For the user who demands a rod with uniform ability to break up into small chips, an alloy is supplied which regularly contains substantial quantities of beta. This, because it is brittle at room temperature, adds to the chip-breaking ability of the lead already there. This rod is, therefore, particularly good for high-speed forming and drilling applications. On the other hand, it is the least ductile and can therefore be formed and headed to the least extent.

Cold forming. The usual and more numerous special applications require uniform ability to be cold-worked—as in roll-threading, knurling, heading, and other deforming. Properties of these special rods are refined by heat treatment or special drawing operations so that the rod can be consistently cold-worked. Normally, there is little sacrifice in machinability, but there is some loss in the ability of the rod to break into small chips.

Deep drilling. In small rod particularly, there has been an increasing demand for material that can be drilled to close tolerances. Special drawing and heat treating practices were developed to produce a rod which performs uniformly, even in such exacting applications as ball point pen tips.

High Strength. And for those applications calling for uniformly higher strength than the usual material, there is a rod produced by special drawing practices.

Technical assistance. If you have a special problem—whether it involves a variation of free-cutting brass or another free-cutting or engineering copper alloy—call in your Anaconda American Brass representative. He'll make available to you the experience and services of metallurgical and mill specialists. Or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 8145

FOR MORE INFORMATION about Anaconda Rods for Screw Machine Products—including physical properties, mechanical properties, composition and machinability — write for Publication B-14. Address: Anaconda American Brass Company, Waterbury 20, Connecticut.

Metallurgical Comment

Free-Cutting Brass can provide relatively wide variations in temper and ductility within the range of composition defined in ASTM and Government specifications (60 to 63% Cu, 2.5 to 3.7% Pb, remainder Zn).

In the commonly available rod temper, referred to in ASTM specifications as "half hard" and more commonly in the trade as "hard," tensile strength may range from 50,000 to 70,000 psi, depending on the rod size and the manufacturer.* And there can be a comparable variation in cold-working properties.

Here's why. The range of 60 to 63% copper was selected for free-cutting brass because it is the lowest which can be used to produce an alloy that can be hot-worked readily and also cold-worked. This means a brass that can be hot-extruded down to small sizes—and that later can be cold-worked to a modest degree.

In more technical terms, free-cutting brass is at the transition point between the alpha phase (the ductile form of the alloy) and the beta phase (the form that's hard and brittle at room temperature but readily worked when hot). Thus, relatively minor changes in composition and fabrication practices can make substantial shifts in the proportion of alpha and beta grains—hence in strength and ductility. Various combinations of these properties can be maintained uniformly by careful control of mill practices.

Free-cutting property of the alloy is, of course, provided by lead dispersed through it—and is not materially affected by changes in other properties.

Standard Anaconda Free-Cutting Brass-271 has a composition of 61.50% Cu, 3.25% Pb, 35.25% Zn. This composition and the mill procedures used are designed to provide a rod which will fit the great majority of high-speed screw machine work.

*In special hard temper the tensile strength of small sizes will approach 90,000 psi.

ANACONDA®
FREE-CUTTING ROD
Anaconda American Brass Company

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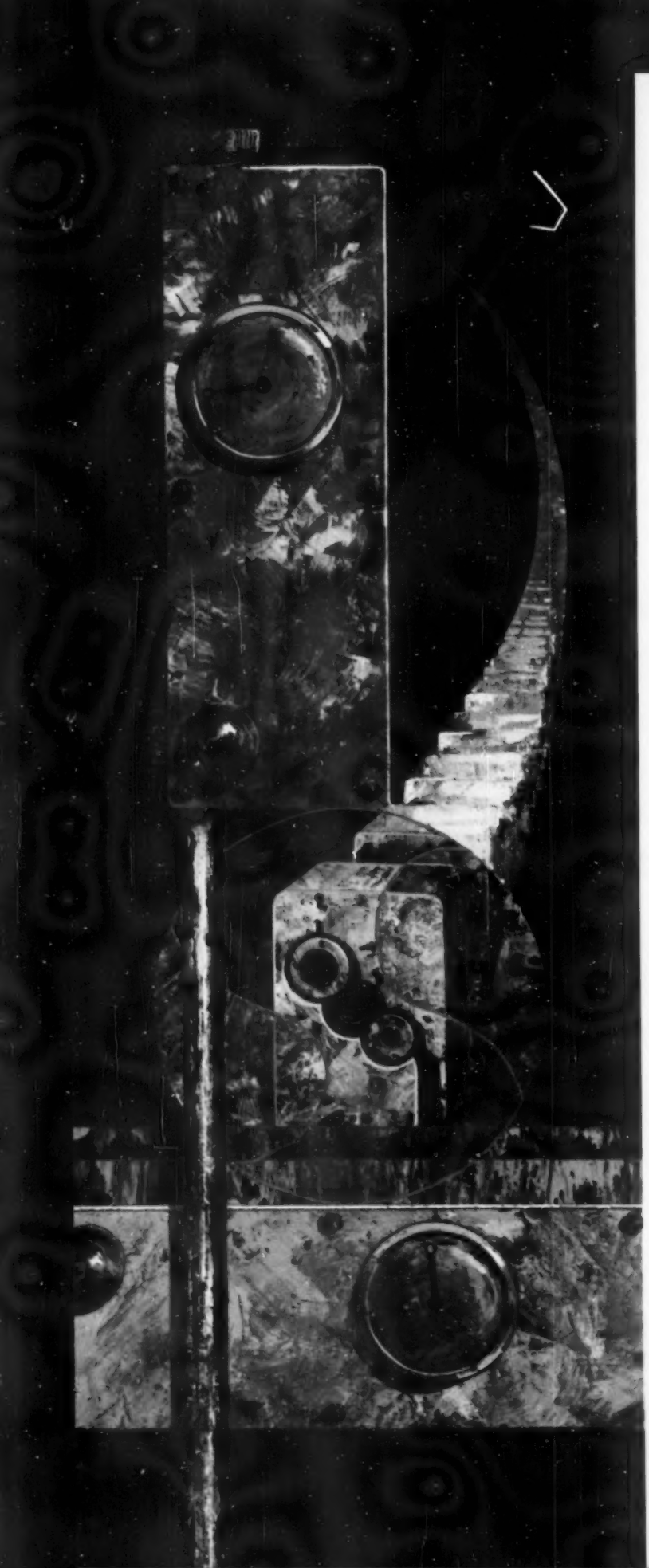
Use Reader Service Card, CIRCLE 41



When you think of RELIABILITY

Lucas automatic power positioning

automatically repeats

automatically repeats

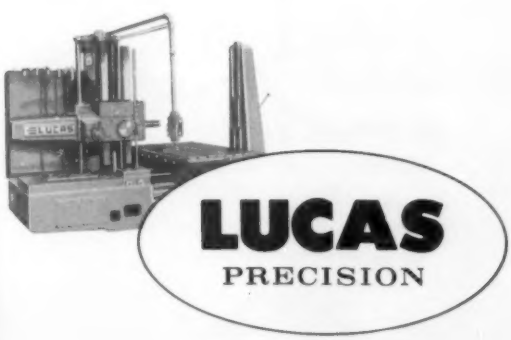
automatically repeats

to ±.0001 . . .

A simple, completely reliable system of dial indicators, end measures, and electrical controls automatically disengages rapid traverse, engages the fixed, constant-rate power feed and precision stops the unit at predetermined settings. Automatic power positioning assures the highest order of repetitive accuracy with an absolute minimum of operator attention.

A new catalog describes our complete line of horizontal boring, drilling and milling machines. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Reliability . . .

think of . . .



LUCAS
PRECISION

When you think of PRECISION

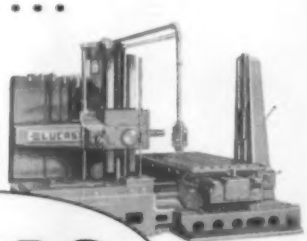
For life time precision Lucas provides

airlift to saddle

and table.

These elements are supported on a thin film of lubricated compressed air during traverse. This separation of metal from metal virtually eliminates wear. During machining cycles the saddle and table are automatically clamped down tight to provide absolute rigidity for even the heaviest cuts. Unclamping is automatic, too. These are two aspects of Lucas design which contribute to the precision of these machines. Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Precision . . .

think of . . .



LUCAS
PRECISION

Tooling Up for ASTME's Future

The Chapter Chairman's Conference held in conjunction with the New York Annual Meeting has prepared all of our leaders, both national and chapter, for the tremendous task of guiding our Society through the coming year and preparing for the next decade.

The demands that will be made for increased manufacturing productivity will fall largely into our area. We will be required to meet them with increased efficiency during a period of vastly accelerated technological research and development. Even today it is a job that cannot be faced alone with any hope of success and we must all pull together to make our Society the indispensable "tool" of the professional tool and manufacturing engineer. Obviously, if we are to assume this role, our Society must undergo some aggressive planning and retooling of its own. The very characteristics of the manufacturing engineer's know-how will undergo great change during the coming decade. We must not become complacent.

Some years ago, David Sarnoff predicted that: "In years to come we will have learned to extract atomic fuel economically. Nuclear energy will become practical for peacetime uses. Direct conversion of atomic energy into electricity will be developed. Solar energy will become another source of power. Television in full color will be completely global, with instantaneous two-way private communication. By means of jet and rocket propulsion the world's leading cities will be only hours apart. There will be new materials, cold light providing illumination without heat. The housewives' dream of an all-automatic home will be realized. Electronic devices will do the cooking, the dishwashing, dispose of waste; temperature and humidity will be constantly controlled and the air will be purged of bacteria."

I thoroughly agree with General Sarnoff that all of this is becoming economically feasible for use in the next 15 years. But within the next ten years, the ingenious, imaginative, inventive tool and manufacturing engineer, descendant of Eli Whitney, must come up with the manufacturing plans to produce these new products for the world to enjoy.

In the workshop sessions held during the Conference it was gratifying to see how the various chapter chairmen approached the problems presented to them. I am certain that our engineering training will enable us to solve the immediate problems as well as those that we will encounter on the way to 1975.

W. Moreland

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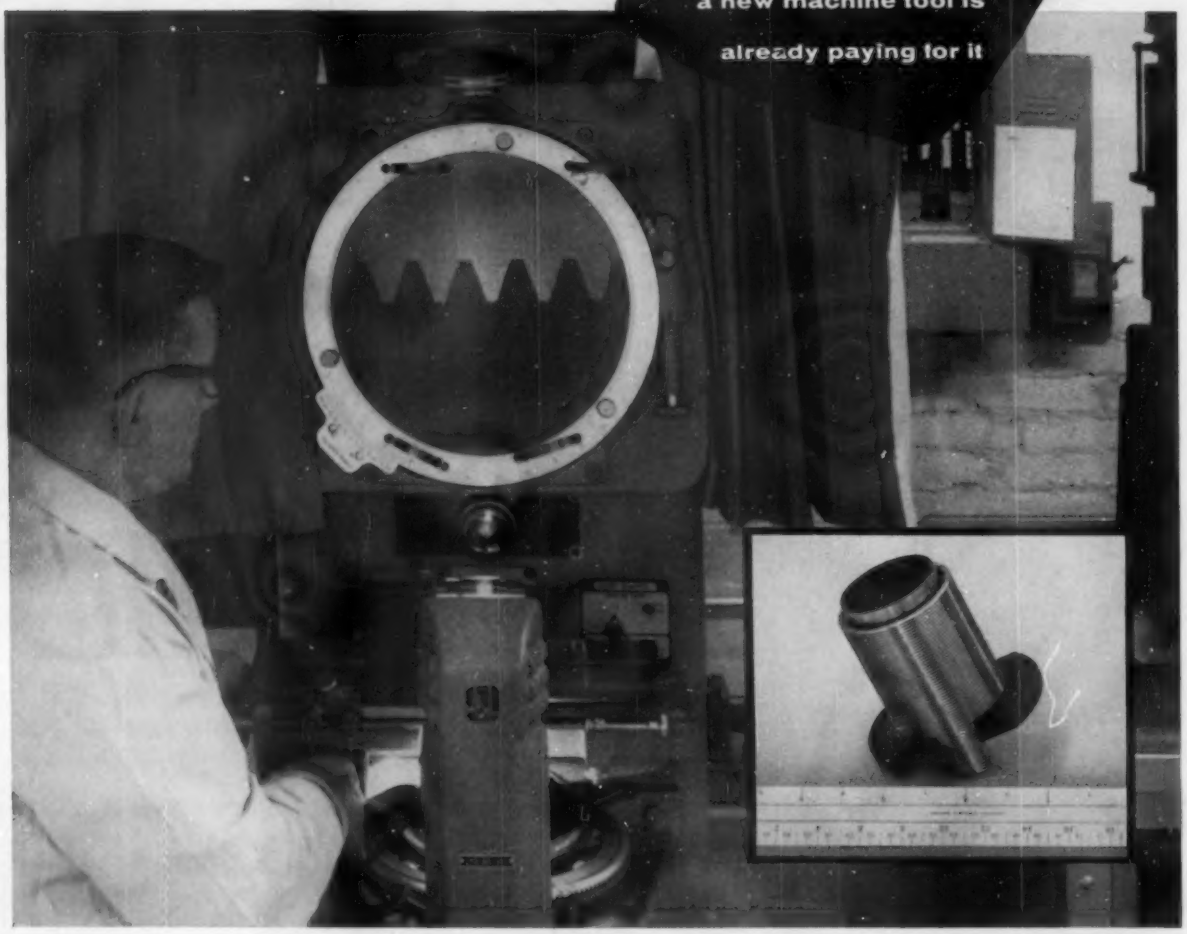
the man who needs a new machine tool is already paying for it



Unretouched photo (above) shows this cylindrical rack being inspected at 62.25X. Photo, courtesy of Baird-Atomic Inc., Cambridge, Mass.

4000% Increase in Inspection Efficiency through use of a J & L Optical Comparator

Baird-Atomic, Inc., Cambridge, Mass., manufacturer of scientific and research instruments needed a rapid and precise method for the quality control measurement and inspection of various components. After experimentation with various types of inspection equipment, a J & L FC–14 Optical Comparator was given a trial. It met all requirements perfectly.

The inspection of a cylindrical rack, heart of the Baird-Atomic Periscopic Sextant, used in advanced aircraft, gives an illustration of the J & L Comparator's efficiency.

The rigid quality control tolerances for this part include: tooth-to-tooth tolerance, .0002″; tooth-to-tooth error, .0003″; composite error, .0003″; pitch dia. within .0005″; concentricity within .0005″ TIR.

Adequate inspection and measurement by conventional methods proved laborious and time-consuming: inspection rate was little better than one rack per day. Now, using a J & L FC–14 Optical Comparator, average inspection rate is 42 per day, an increase of approximately 4000%!

Investigate the possibilities of J & L Comparators in *your* production set-up. Available in 12 different models, both floor and table types.

Write today for Comparator Catalog 5700. Jones & Lamson Machine Company, 518 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

industry wants

TRAINED MANUFACTURING ENGINEERS

By W. Karl Somers
Assistant Professor
Dept. of Tool and Manufacturing Engineering
Utah State University

When top industry leaders were asked whether their companies would benefit from college-trained tool and manufacturing engineers, their answer was a resounding yes. And they had some specific ideas about the subjects that should be emphasized in a tool and manufacturing engineering curriculum.

THERE'S A REAL NEED for college trained tool and manufacturing engineers in industry today. That's one of the findings resulting from a survey conducted by Utah State University. During the course of the survey, hundreds of top executives from the manufacturing industries were polled. Over 98 percent of these executives answered "yes" to the question: "Do manufacturing industries have a definite need for engineers who have had an engineering curriculum with emphasis on courses in tool and manufacturing engineering?" And 100 percent said that engineering education with emphasis on courses in tool and manufacturing engineering would receive ready acceptance by manufacturing industries. In answer to a third question, more than 95 percent of the manufacturing executives surveyed would prefer engineers who had taken an engineering curriculum in which tool and manufacturing engineering was emphasized.

Some other findings: 28 percent of all the engineers in manufacturing industries have manufacturing responsibilities. Further, 38 percent of mechanical and industrial engineering graduates go into some phase of manufacturing.

Traditionally, the supply of tool and manufacturing engineers has come from the ranks of highly skilled craftsmen and technicians. Industry sponsored training programs, self-assigned study and many years of diversified experience in machine tool operations and manufacturing processes, all combined to produce a trained tool and manufacturing engineer. Often working with formally trained engineers, these men were responsible for the growth of American manufacturing from the time of Eli Whitney to the present.

It can be inferred from the survey, however, that the rapid advances in production processes and techniques, combined with a shortage of men with production know-how on the engineering team in many plants, have resulted in the need for engineering education that combines training in the basic sciences of engineering with an understanding of manufacturing equipment, materials and processes.

The executives surveyed do not visualize a four-year college curriculum in which all courses deal with tool and manufacturing engineering. They feel that all of the basic fundamentals of a typical engineering course should be included. For a ma-

jor in tool and manufacturing engineering, courses in manufacturing subjects would replace such courses as power plant engineering, steam and combustion engines, thermal energy systems, refrigeration and air conditioning, aerodynamics and structural design.

Industry had some definite recommendations concerning the courses that should be taken by prospective tool and manufacturing engineers. These are shown in the accompanying chart. As might be expected, a course in manufacturing processes leads the list. Industry regards this as the most important course in a tool and manufacturing engineering curriculum. It is followed closely by a course in machine tool performance and a course in manufacturing analysis. The fourth most desired course—technical report writing—comes as a surprise, since it ranks higher than such bread-and-butter courses as machine design and production tool design, and far higher than courses in automation, plant layout and metallurgy.

This points up an important finding from the survey. In addition to the basic engineering fundamentals, industry, in general, wants courses that are specifically related to tool and manufacturing engineering, rather than courses in subjects that are somewhat more distantly related to manufacturing problems, such as electronics, thermodynamics and the like. But when choosing between various manufacturing engineering courses, industry prefers courses that require training in the analysis of manufacturing operations, rather than courses dealing with hardware only. Thus the course in machine tool performance is rated significantly higher than the course in machine tool design and a course called "Manufacturing Analysis" is the third most popular course out of a total of 32 courses listed. This emphasis on analytical training may account for the high rating given to the technical report writing course as well, since report writing involves analyzing a situation and coming up with some well-thought-out—and well-stated—answers.

Although the Utah State study was not comprehensive enough to give direction toward the establishment of individual course objectives or detailed syllabi, it conclusively established the nationwide need for educational programs directed toward tool and manufacturing engineering. The modern trend toward education in the theoretical, rather than the practical, engineering sciences can shortchange the manufacturing industries, who are looking for engineers who can take a product design and determine how to manufacture that product with high efficiency and high quality.

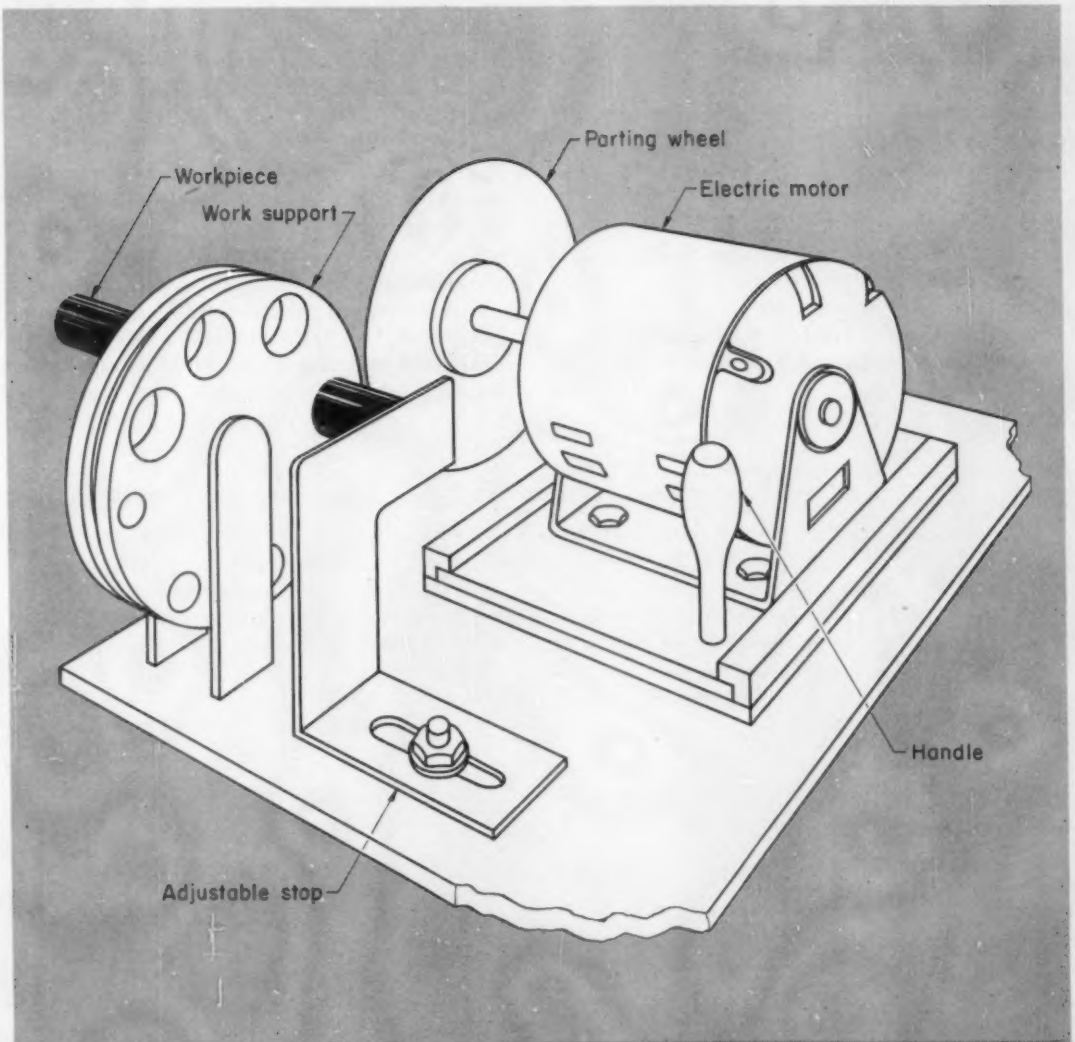
The Courses Industry Wants

(courses with highest number are in greatest demand)

174 Manufacturing Processes	129 Engineering Metallurgy
173 Machine Tool Performance	128 Electrical Circuits and Control
169 Manufacturing Analysis	127 Statistical Analysis
163 Technical Report Writing	124 Production Control
159 Machine Design	122 Fluid Mechanics and Hydraulics
159 Production Tool Design	122 Management and Supervision
155 Engineering Mechanics	120 Personnel Relations
149 Tooling Standards	118 Dynamics and Kinematics
147 Strength of Materials	117 Composition
144 Engineering Economy	116 Electronics
142 Manufacturing Research Problems	116 Industrial Cost Accounting
138 Stresses in Machine Elements	116 Speech
138 Production Planning	106 Basic Economics
137 Motion and Time Study	99 Computer Programming
135 Automation Programming and Controls	99 Thermodynamics
130 Plant Layout and Material Handling	94 Differential Equations

Gadgets

Ingenious Devices And Ideas



Motorized Unit Slices Tubing

Designed for economical cutoff operations on plastic tubing, this machine consists of an indexing work support unit, a movable motor and a steel parting wheel. In use, tubing is inserted in the proper hole in the support unit and indexed to correct cutoff position. The motor is then advanced manually until the parting wheel cuts through the workpiece.

Amos L. Shellum
Minneapolis Chapter

1961 Gadgets Contest

Now's the time to start thinking about the 1961 Gadgets Contest. Open to all ASTME members, the contest will run from October 1 to December 31, but don't wait!!! Send in your entries—as many as you like—to the Gadgets editor *now*.

All entries submitted will be reviewed by your National Editorial Committee and judged on the basis of originality, conciseness and completeness of presentation. A first prize of $100, two second prizes of $50 and four third prizes of $25 will be awarded with honorable mention awards going to all close runners-up. A copy of either the *Die Design Handbook* or the *Tool Engineers Handbook* will accompany all honorable mention awards. All entries showing information of use to other engineers will be published and honorariums will be paid for their use. A complete list of winners and runners up will be published in THE TOOL AND MANUFACTURING ENGINEER.

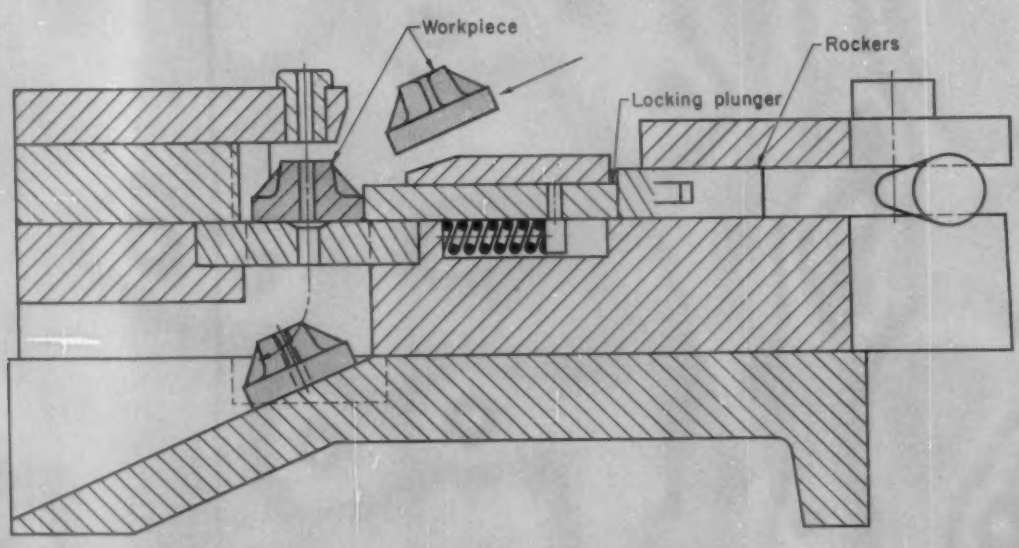
In submitting your Gadget, don't forget to mention your name and chapter affiliation on each page of your manuscript. And please try to limit your entry to 500 words or less. Finished drawings are not necessary—rough, but legible sketches of your idea are sufficient.

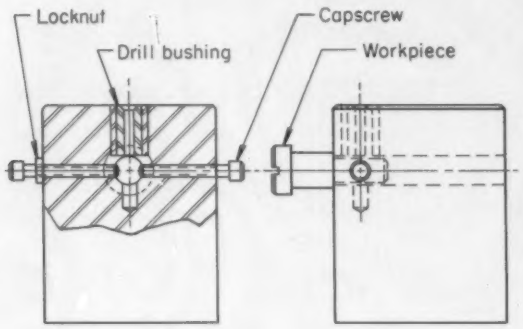
It is understood that all entries will become the property of THE TOOL AND MANUFACTURING ENGINEER and that none will be returned.

Sliding Base Speeds Fixture Unloading

Utilizing a sliding base plate actuated by a pneumatic cylinder, this jig makes part unloading automatic. Work to be drilled is loaded and clamped manually in V-blocks mounted over angled escape chutes. After drilling, the base plate, in which escape holes are machined, it is moved by the cylinder to a position in which the holes are directly beneath the work. The clamps are then released and the work falls out of the fixture.

Hjalmer Dahl
Upplands Vasby, Sweden



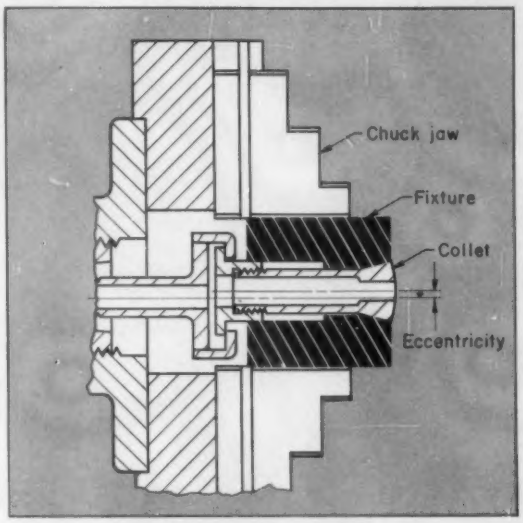


Inexpensive Fixture Solves Tooling Problem

When production runs of parts requiring diametral holes are too small to justify jig boring or expensive tooling, drill fixtures of this type provide an economical solution to the tooling problem. A piece of cold-rolled steel, a liner bushing, two socket-head cap screws and a locknut are the only materials required.

Part positioning is effected by placing the workpiece in a hole which is drilled 0.015 inch oversize. One screw, secured by the locknut, provides accurate part centering. The other screw locks the part in position.

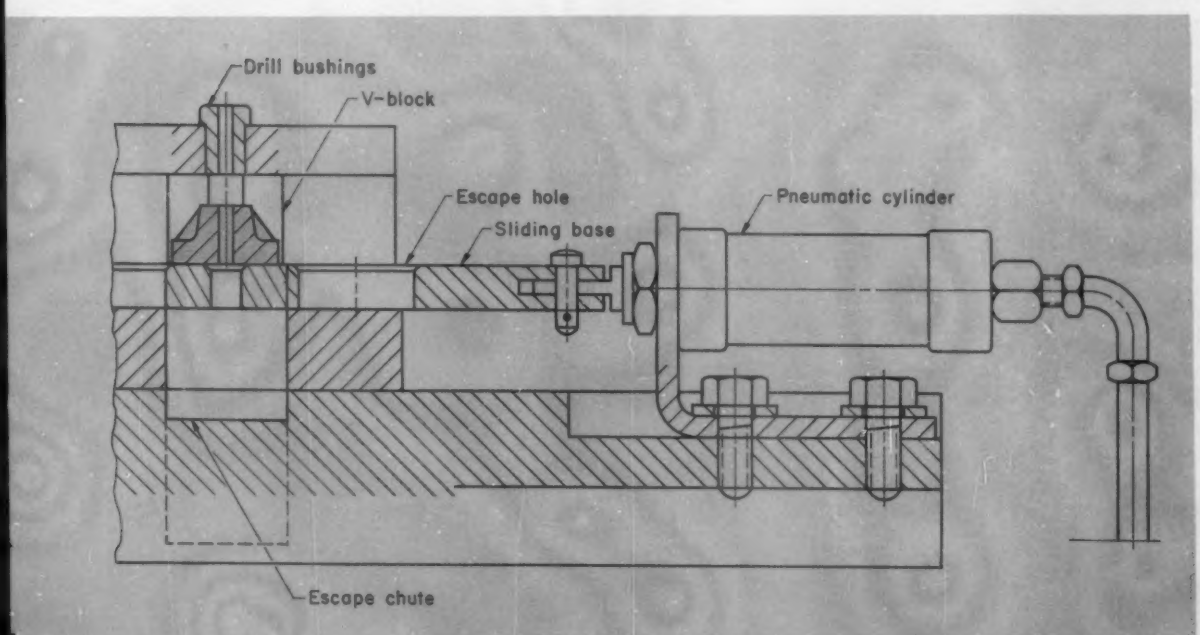
Daniel J. Forward
Pomona, Calif.



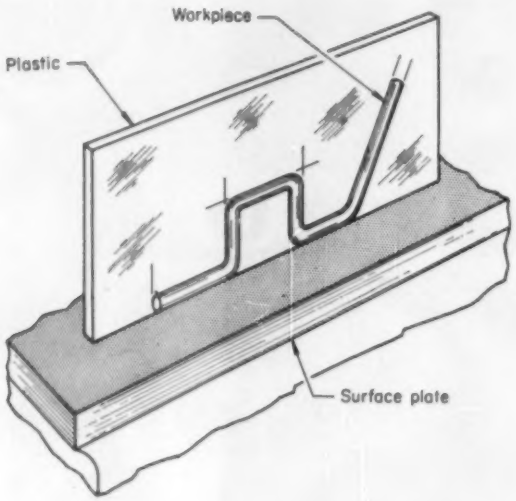
Fixture Puts Collet Off-Center

Eccentric turning of small parts can be accomplished easily and accurately with this collet fixture. Setup consists of mounting the fixture in a four-jaw chuck and indicating it to required eccentricity. The collet can then be inserted and secured with a conventional drawbar.

Ernest Jones
Bronx, N. Y.



Gadgets



Plastic Gage Speeds Inspection

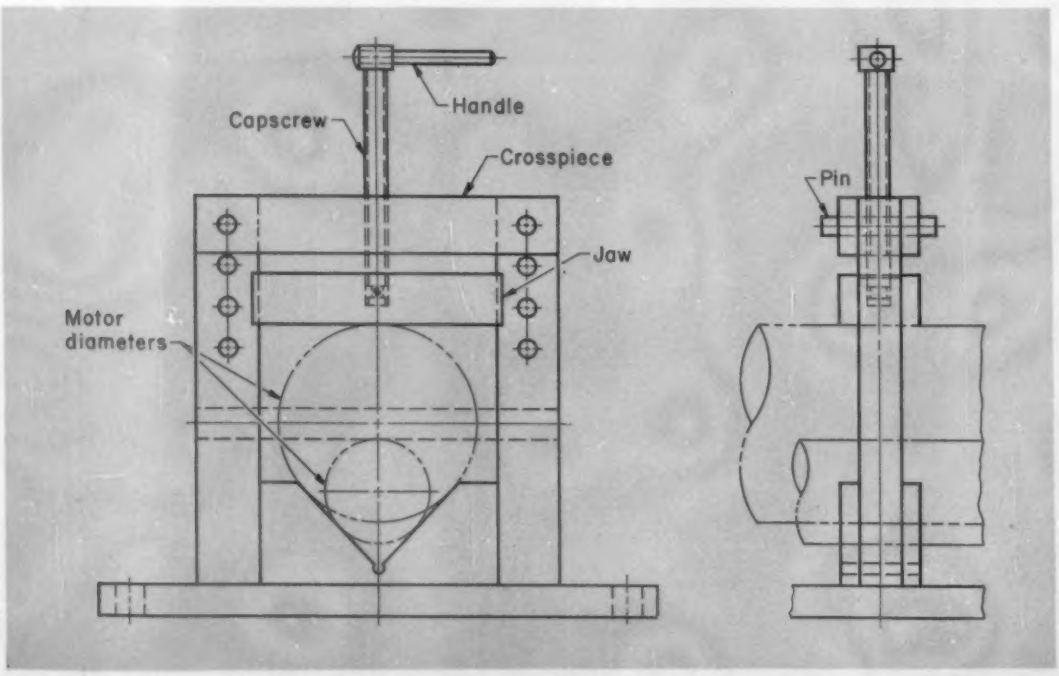
Visual inspection of small-lot production items can be simplified with gages of this type. Main body of the gage is clear plastic which is machine squared for layout purposes. After squaring, lines representing the workpiece contour are scribed on the plastic with a height gage. Dyes, layout fluid or other coloring mediums wiped into the scribed lines facilitate the task of "sighting-in" the part.

John M. Breen
Pittsburgh Chapter

Special Fixture Simplifies Electric-Motor Repairs

Designed to replace conventional bench vises in the repair of electric grinders, this special V-block can be quickly converted to hold either diameter of the workpiece. Conversion is obtained by raising or lowering the crosspiece to desired heights in the two uprights. Support is provided by pins inserted through the uprights and crosspiece. After the workpiece and crosspiece have been positioned, clamping is effected by tightening the socket-head screw.

H. Perina
Hinsdale, Ill.



GUN DRILLING
—universal machine provides for economical short runs

By Duncan J. Brown
Field Engineer
Brown & Sharpe Mfg. Co.
Providence, R. I.

Although economical when high production justifies the use of special purpose machines, gun drilling has been less economical for short runs. A universal machine extends the scope of gun drilling to short-run work by reducing setup and fixturing costs.

Fig. 1. By mounting a gun drilling unit on a universal milling machine, gun drilling acquires versatility for handling short-run work economically.

GUN DRILLING produces straight clean holes with a fine finish that do not wander off center, even when they intersect other holes, but remain true as a rifle bore. This often eliminates the need for secondary reaming operations. These characteristics and the high cutting rate obtainable by feeding coolant under pressure explains the use of gun drilling for high-production work. Its use for short-run jobs has been limited by the complexity of the equipment—whip guides, chip box, glands, coolant units—required in addition to the basic drilling machine.

The machine shown in *Fig.* 1 combines a gun drilling head and a universal knee and column base to bring the advantages of gun drilling to short-run work. This provides great flexibility through the simplicity of setup and operation. It requires a minimum of tooling, extending the scope of operation to short runs. By adding standard accessory equipment, operation can be increased to include high-production runs.

The universality of the machine derives from the knee type design and from the precision installation of the drill head on the column. A workpiece can be situated anywhere within the machine's working cube by appropriate movement of the knee's three orthogonal axes. On the column, a precision platen is fitted for mounting the drill head. To this platen, a selected drill head and chip box is fitted, the chip box being placed in alignment with the axis of the drill spindle. Two variables affect selection of the drill head—speed range and feed range. The drill head unit is chosen to match these to the type of drilling that will be encountered. Pumping and filtering capacity of the coolant supply unit is similarly matched to the range of machining conditions anticipated. Glands for transferring coolant under pressure to the spindle are also chosen to meet machining conditions. For instance, if most of the drilling is to be small bore, high-pressure gland seals and high-pressure coolant pumps are required to force coolant through the

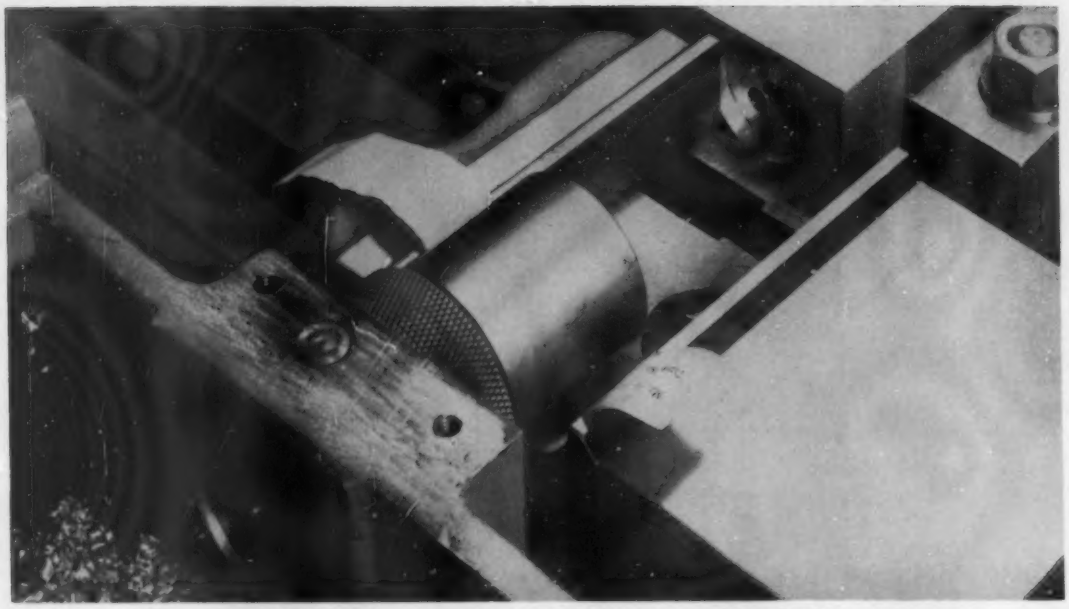


Fig. 2. Assembling a plug gage into the chip box front bushing simplifies setup. Chip box eliminates need for splash guarding and leaves work area uncluttered.

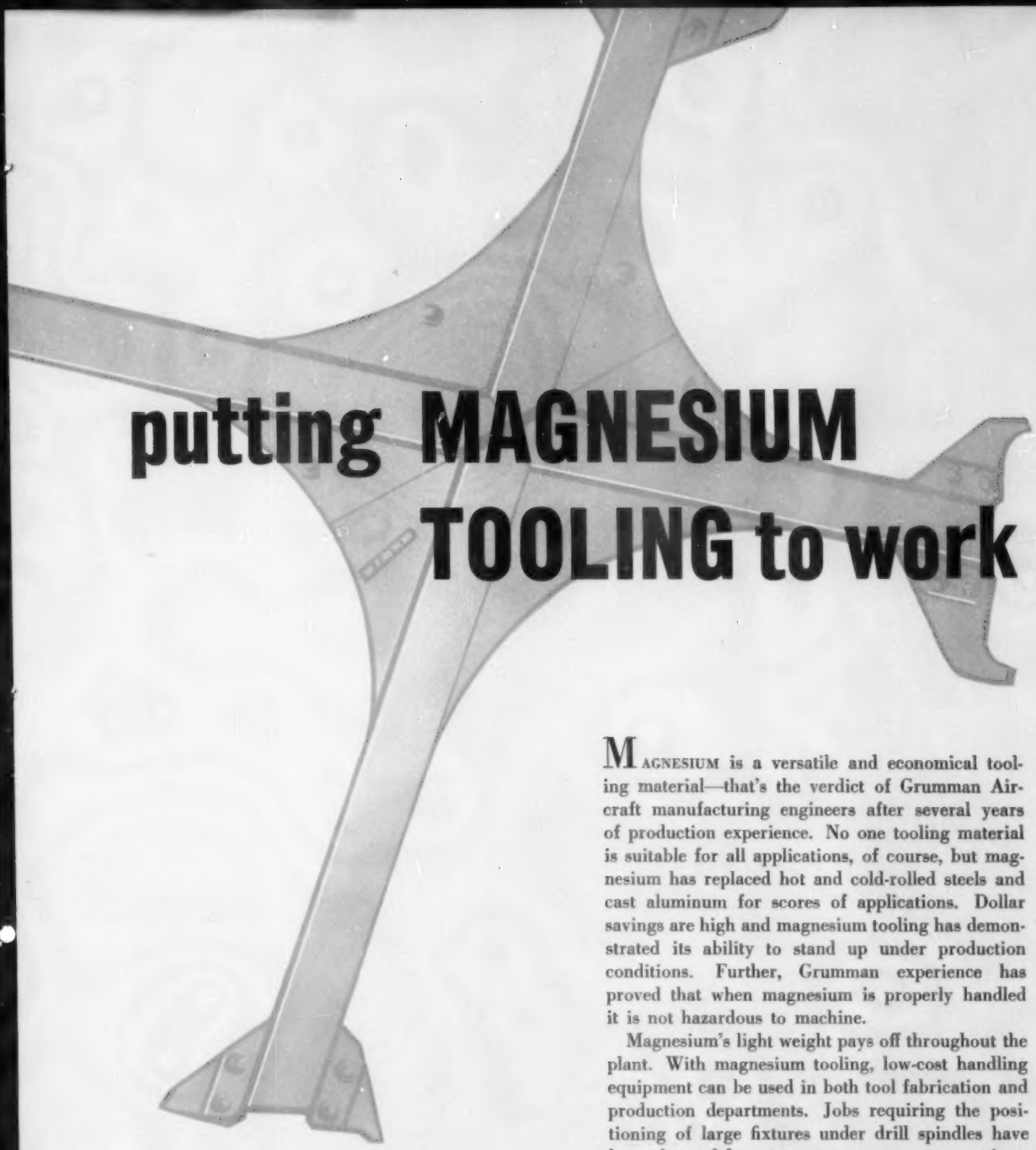
small coolant passages in the drills. High-speed spindles are needed to reach satisfactory cutting rates. For large bore work, pressure is less important than rate of flow, seals and spindle speeds are less critical.

The chip box, through which the drill passes on its way to the workpiece, serves as a collection point to deflect oil and chips from the drill flute to the coolant reservoir. This is visible in the center of *Fig.* 1. The rear bushing provides support and acts as an antiwhip guide. Since the chip box and both bushings are precisely aligned with the spindle axis, the front bushing serves as a reference point for setting up and fixturing jobs.

During setup, a plug gage is assembled in the front bushing hole of the chip box thereby placing the center line of the plug gage in line with the drill spindle axis. The knee is then adjusted to some convenient zero reference point and a holding fixture, such as the vise shown in *Fig.* 2, is set to the plug. Once the reference point is established, all holes to be drilled can be located accurately by means of the longitudinal and vertical screws and dials. The setup is quick and easy and eliminates the need for expensive fixturing. In short-run work several holes can be drilled in one clamping to a center distance tolerance of 0.001 inch. For closer control of tolerances, optic setting arrangements reduce tolerances to about 0.0003 inch. For odd shaped workpieces special fixtures might be required simply to hold the piece, but costly spacer blocks are not needed for hole location. The horizontal saddle movement is used to withdraw the workpiece from the chip box without disturbing the original clamping for changing drills and drill bushings.

Other setups are readily improvised, which reduces lead time and fixturing costs. Rotary tables and automatic indexing fixtures are easily aligned to the drill axis for drilling holes positioned radially around the circumference of a workpiece. Angle plates are similarly easy to align and clamp. When jobs are encountered that frequently recur in small runs, two or three setups are left on the table. Changeover from one to another is quick and usually consists only of changing drills and bushings, speeds and feeds, and moving from one working area to the adjacent area. For higher production jobs, the large working area of the table is used for double station drilling. With the addition of tape control to position from hole to hole and trigger the drilling cycle, the economic distinction between long and short runs becomes less critical. The machine is almost equally adept at handling both.

About a hundred years ago, the first universal knee type machine was developed to produce twist drills for boring guns. Its descendant in this form now drills holes with accuracy and fine finish in a variety of workpieces. The machine retains its original adaptability and enables economical short-run gun drilling by reducing lead time and fixturing costs. With standard attachments or with tape control, the same machine can handle medium to high-production runs with similar speed and economy—a real breakthrough in drilling.



putting MAGNESIUM TOOLING to work

By Jack M. Hockett

Manufacturing Engineering Standards
Grumman Aircraft Engineering Corp.
Bethpage, Long Island, N. Y.

When Grumman Aircraft engineers put magnesium tooling to work, they found that savings in tooling cost were substantial, with no sacrifice in tooling quality or reliability.

MAGNESIUM is a versatile and economical tooling material—that's the verdict of Grumman Aircraft manufacturing engineers after several years of production experience. No one tooling material is suitable for all applications, of course, but magnesium has replaced hot and cold-rolled steels and cast aluminum for scores of applications. Dollar savings are high and magnesium tooling has demonstrated its ability to stand up under production conditions. Further, Grumman experience has proved that when magnesium is properly handled it is not hazardous to machine.

Magnesium's light weight pays off throughout the plant. With magnesium tooling, low-cost handling equipment can be used in both tool fabrication and production departments. Jobs requiring the positioning of large fixtures under drill spindles have been changed from two-man to one-man operations. And in assembly departments, Grumman production personnel report that they experience little fatigue when using magnesium assembly and installation fixtures, even when reaching overhead and backward into hard-to-get-at fuselage areas.

A 10-foot-long magnesium structure used to install a modified nose section in a rescue aircraft, *Fig.* 1, illustrates the advantages of magnesium's light weight for large tooling. This mobile installation fixture weighs less than 200 lb and it can be positioned with light hand pressure. The airplane is cradle mounted during this operation and the fixture is canted by means of a jackscrew to

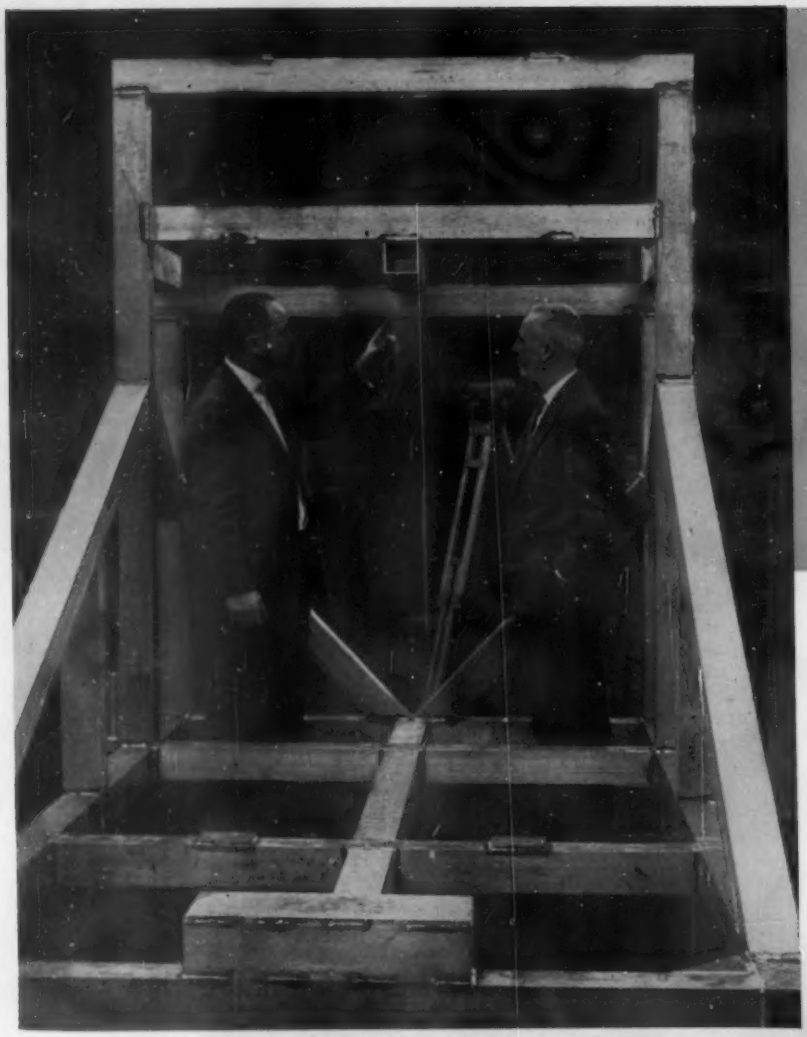
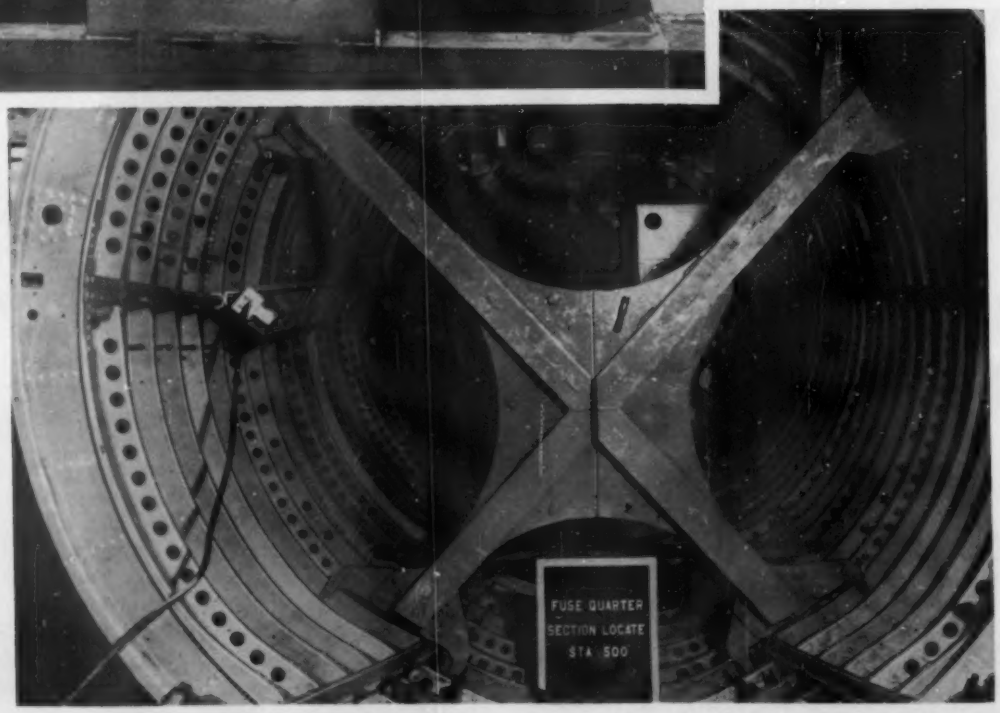


Fig. 1. Magnesium fixture used to install an aircraft nose section. Because of its light weight, this fixture can be lifted and positioned without difficulty.

Fig. 2. (below) This magnesium installation fixture weighs only 30 lb. The light weight is important when working in the confined interior of an aircraft fuselage where mechanical lifting devices often cannot be used.



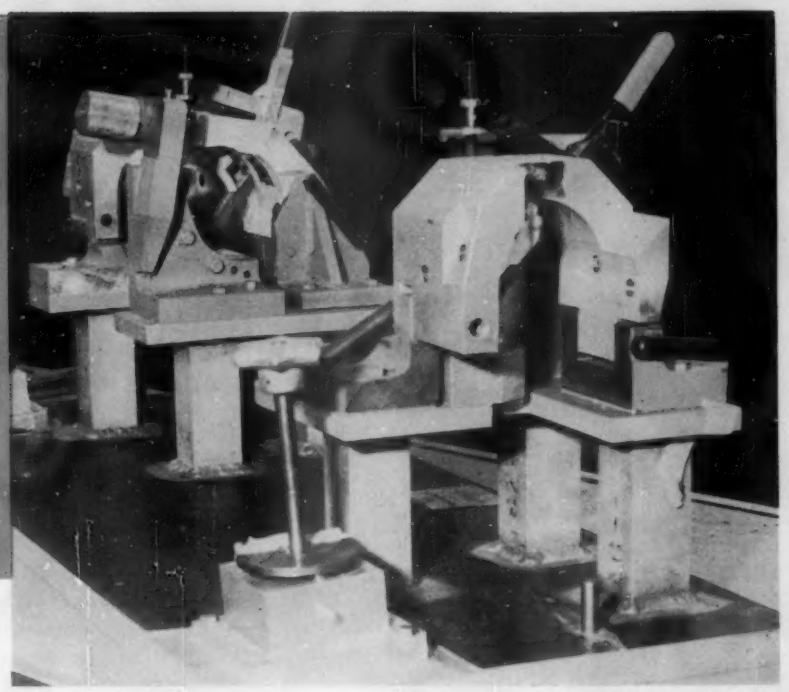


Fig. 3. Lightweight magnesium box jig. Weighing 38 lb., the jig can be moved into working position manually by one man.

make the centerlines of the fixture and the aircraft coincide. The jackscrew adjustment is important, since it allows movable fittings on the fixture (not shown in the illustration) to pick up the nose wheel hinge pin, door hinge and bulkhead of the aircraft. Elevation is much easier because of the light weight of the fixture.

Another magnesium installation fixture is shown in *Fig.* 2. It is used to maintain the shape and rigidity of the aft fuselage of an aircraft prior to final riveting of four panel sectors and the joining of fuselage subsections. Because this split section must pick up holes predrilled in the panels and must be assembled and broken down in the narrow confines of the fuselage, it must be light enough for one-man installation. Of magnesium, the entire fixture, which is approximately six feet across corners and which is fabricated of welded four-inch channels and ¼-inch plate, weighs about 30 lb. One man can handle it easily.

Magnesium was used for all components of the box type jig shown in *Fig.* 3, excepting bolts, pins and clamps. Its light weight—38 lb—means that the fixture can be moved by one man to and from the work station and can be easily turned on its side for drilling side holes. The sculptured blocks are of magnesium, selected because of its machinability; the base is of ¾-inch-thick magnesium plate. Six pedestals of three-inch-square magnesium tubes are welded to the base plate.

Magnesium is as weldable as other common tooling materials. After welding, all of these materials are stress relieved. Magnesium is stress relieved at lower temperatures and in less time than steel or aluminum. The comparative temperatures and time are: steel, 1200 F for one hour for each inch of thickness; aluminum, 600 F for six hours; and magnesium 500 F for one hour. All things being equal, these lower temperatures and shorter times make stress relieving costs lower.

The wear resistance of magnesium is good. In any event, since most aircraft tools are made for short-run production, wear resistance is not of primary concern. In a Grumman laboratory test, the bore for a standard slip renewable bushing in a specimen of magnesium tooling plate wore only 0.0005 inch after 5000 bushing insertions and withdrawals.

The as-received flatness and surface finish of magnesium tooling plate and extrusions are adequate for most structural supports. Sculptured tool details that require a great deal of machining present the greatest potential for savings. Magnesium can be machined about 45 percent faster than aluminum. Heavier milling cuts can be taken at higher feeds. And cutting tools used for machining magnesium require sharpening less often than tools used to cut other materials.

Another advantage of magnesium for tooling is that it shows less deflection due to its own weight than steel or cast aluminum of the same cross section. For heavily loaded beams, steel sections are usually preferred. But machining economy may still dictate the use of magnesium, with proportionately increased cross sections.

Because magnesium has the same—or approximately the same—coefficient of thermal expansion as most aircraft part materials, it promotes part interchangeability. Master tools, the tools used to make jigs and fixtures, were previously made from steel because steel offered rigidity and a low coefficient of thermal expansion. However, when mating parts are subcontracted, they may be made in two different plants with different ambient temperatures. Rework at the time of final assembly can be anticipated unless stringent temperature controls are maintained in all plants. Magnesium tooling has cut this type of rework to a minimum.

Like any tool material, magnesium is subject to corrosion. To protect magnesium tools during use and temporary outdoor storage, Grumman engineers use an epoxy paint system. Surfaces are precleaned, primed with an epoxy primer, then painted with an epoxy topcoat.

Water-soluble shimming and potting plastics and plasters corrode magnesium. An application of polyvinylchloride in liquid or impregnated tape form gives adequate protection.

The principal problem connected with the use of magnesium tooling is safety. This problem has been satisfactorily solved by segregating magnesium machining operations, such as sanding, jig boring, and slab and extrusion sawing, from other operations in the plant.

Another type of problem was encountered on jobs in which plaster shimming material was drilled in combination with magnesium. The magnesium packed in the drill flutes, resulting in frictional heating that caused the magnesium to flash. This trouble was eliminated by using high-helix drills, which remove the plaster chips rapidly so that the flutes do not pack.

Less than a year after the introduction of magnesium tooling plate at Grumman, it was reported that magnesium has a tendency to creep following machining. Tests comparing ¾-inch magnesium and aluminum tooling plates, jig-bored to close tolerances, were conducted. No appreciable variations in the characteristics of these materials after machining were observed. The location and size of holes remained relatively constant over a period of several weeks.

A third problem was caused by the excellent surface finish of holes drilled in magnesium. Because of the high surface finish, potted bushings did not always adhere properly. This problem was solved by roughing up the holes to produce a better gripping surface for the adhesive.

Grumman engineers calculate that magnesium tooling materials saved the company some $93,000 during 1960. This does not include savings in production areas, where less manpower is needed to handle tools and the fatigue factor is reduced. All in all, Grumman's decision to put magnesium tooling to work has really paid off.

Computer Solves 3-D Design Problems

Research techniques which shorten development time and optimize design of nuclear reactors are being adopted by the Navy since the installation of the Larc II. Officials of the Applied Mathematics Laboratory, David Taylor Model Basin, in Washington, D. C., say the Larc makes feasible for the first time efficient studies of three-dimensional mathematical models of nuclear reactors.

In just a few hours, Larc can stimulate the lifetime behavior of a nuclear reactor core and calculate the performance of various components throughout its power-producing life. It studies and compares many different reactor designs and selects the most efficient design for a specific purpose.

With another technique, ship designers at the Laboratory will determine ship lines on the computer rather than laying them out full scale in a builder's loft. Other problems being considered for solution are calculations related to the design of large arrays of transducers and the automatic control of heavy machine tools used to fabricate ship components. The solid-state system can be geared to handle a range of variables extending from basic scientific research to the preparation of a company's payroll.

Built by Remington Rand Univac Div., Sperry Rand Corp., the Larc operates at the rate of 250,000 additions or subtractions each second. Almost completely transistorized, it contains over 80,000 transistors and 600 vacuum tubes in the two interconnected computers and associated auxiliary devices. The high-speed magnetic core memory of the system stores up to 360,000 characters. An additional 36,000,000 characters can be stored on 12 high-speed memory drums which transfer information at speeds up to 1,323,000 characters per second. Supplementing the high-speed drums are 16 magnetic tape units. Results are produced by a high-speed printer at the rate of 600 lines per minute.

The Larc consists of a main computer unit which works in conjunction with a second computer, called a processor. This allows simultaneous performance of data processing and calculations.

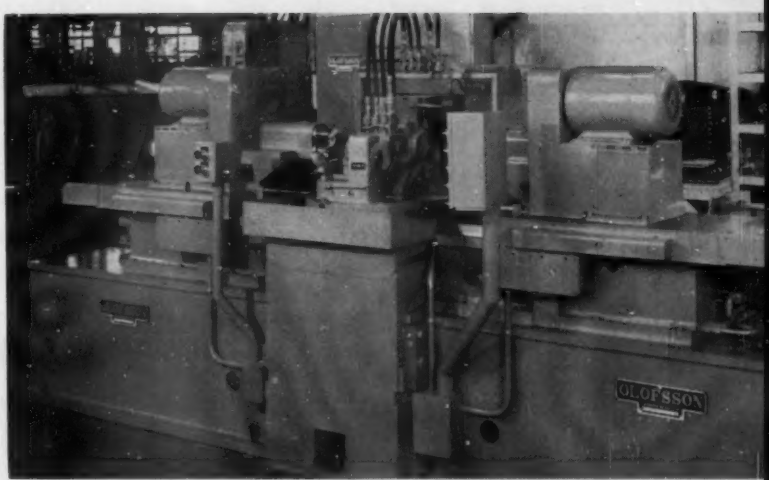
designed for

PRODUCTION

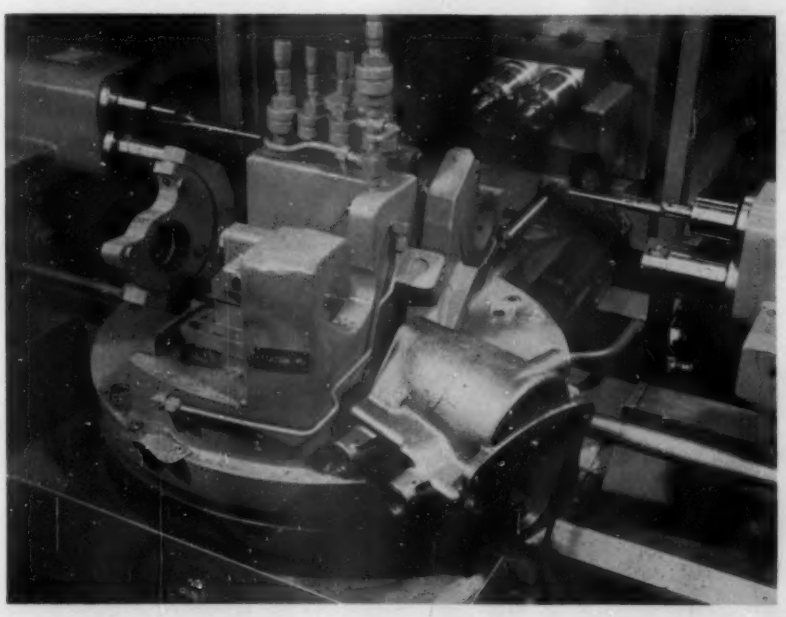
Special Machine Bores Gearboxes

Designed for machining holes in transmission cases, this Olofsson boring machine utilizes an oscillating index table to permit loading at one station and machining at another. During indexing—accomplished with a hydraulically actuated rack and pinion gear—the table is elevated approximately 0.001 inch by air pressure. This eliminates wear and consequent misalignment between boring spindles and workpiece fixtures.

Part positioning in this machine is accomplished with a yoke type lever that incorporates a pivoting clamping leaf. Because this leaf is free to rotate in the yoke, clamping forces are always perpendicular to the fixture base, regardless of workpiece length.



OVER-ALL VIEW of gear box boring machine. All boring operations are performed simultaneously. Parts are mounted on an oscillating index table mounted at the center of the machine.



CLOSE-UP VIEW of index table and tooling area. Workpiece, shown out of position, is located over fixture partially visible behind Station 1.

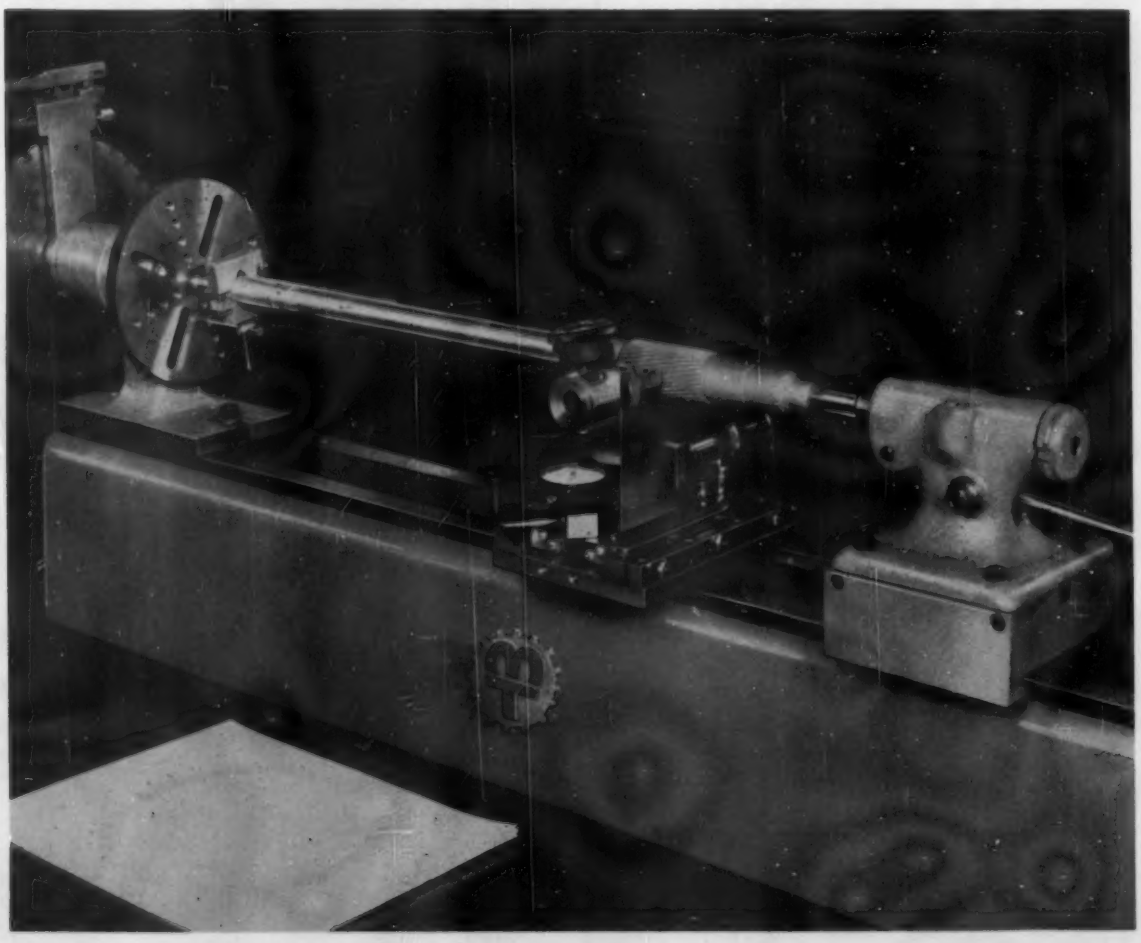
System Inspects Gears by Graphical Analysis

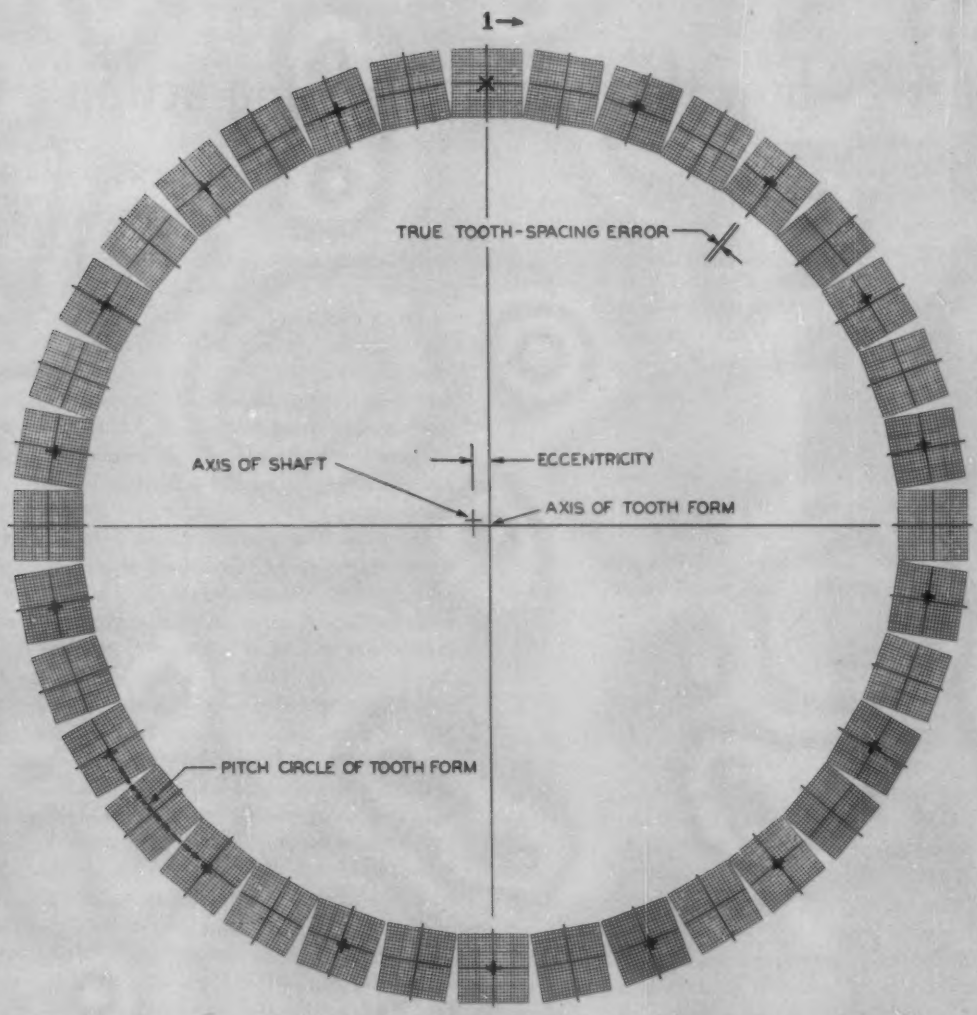
In most cases, faulty gears have errors in tooth-spacing or runout. When errors of both types are present, it is difficult, if not impossible, to evaluate either of them with conventional inspection equipment. In the unit illustrated, a product of Michigan Tool Co., both types of error are separated and accurately measured by graphical analysis.

Heart of the inspection system is a two-indicator slide that is positioned by spring pressure to take readings on each tooth. The upper indicator, which can be rotated to conform to desired helix angles, measures apparent spacing error with a rack type pointer. These readings are recorded by "plus" signs on a circular chart, the radial arm of each sign indicating deviations from correct spacing.

The lower indicator—zeroed at the start of the inspection cycle—records apparent workpiece eccentricity when the slide is placed in its operative position. These readings are recorded by the position of the crossbars on the plus signs. Workpiece indexing then takes place through use of index plates mounted on the checker.

When readings have been taken on all teeth, the operator has a circle of plus signs which present a graphical picture of the pitch circle. This circle, superimposed upon a blank chart at a light table, shows the exact eccentricity and errors in spacing.





Opposite Page

INSPECTION SYSTEM for isolating errors in spacing and eccentricity. Handle visible at rear of slide regulates spring pressure on unit prior to inspection.

Above

TYPICAL CHART showing shaft eccentricity and errors in tooth spacing. Both the indicators on the checker are zeroed at No. 1 position as indicated by cross mark.

GRINDING FLUIDS

part 2—how they affect grinding action

By L. P. Tarasov
Research and Development Dept.
Norton Co.
Worcester, Mass.

Influences of fluids on grinding action depend on the nature of the work material. Quantitative data are presented for steels, high-temperature alloys, and titanium alloys.

WITH SOME EXCEPTIONS involving certain alloys with unusual grinding characteristics, replacement of water-base fluids by grinding oils results in a big reduction in wheel wear. This makes it possible to remove more stock with each wheel, to grind larger areas without wheel breakdown, and to maintain wheel form for a longer time.

Less heat is generated with a grinding oil, as shown by the lower power consumption. This can be helpful in eliminating damage to the surface from the generation of excessive heat but, if there is no need of reducing the heat generated, a harder wheel can be used to decrease wheel wear further, or a heavier cut can be taken to increase the production rate. It is possible to obtain a smoother finish with a grinding oil, and also to use a finer grit wheel to improve the finish further. However, the wheel has to be dressed more carefully to avoid diamond lines, since these persist much longer when oil is used and result in a poorer finish.

In spite of all these advantages, grinding oils are generally used only where needed, inasmuch as they suffer from several important disadvantages away from the area of grinding contact. Although less heat is generated than with water-base fluids, oil is a relatively poor coolant. Thus the work may become too hot to handle if substantial amounts of stock are removed and it may be difficult to meet the required tolerances.

Oil is always used in thread grinding because the form has to be maintained accurately, but the amount of heat generated is small enough relative to the volume of work material so that the temperature of the work does not rise excessively. Similar factors apply to other types of form grinding and also to gear grinding, some of which is done with oils and some with water-base fluids, depending on the operating conditions and the requirements. The other principal drawback to oil is the general messiness associated with it, but this is minimized when the machine is completely enclosed and is properly exhausted to take care of the oil mist. There may be a fire hazard involved in the use of oil, which is discussed in the section on service properties.

In grinding most steels, vitrified-bond wheels wear more rapidly in a wet than in a dry operation, but just the opposite may happen when other

Table 1—Grinding Ratios Obtained in Wet and Dry Surface Grinding

Steel Type (AISI)	Grinding Ratio	
	Wet	Dry
M2	6.4	17
M3 (Type 1)	2.7	5.5
M4	0.9	2.8
T15	0.7	2.5

Grinding conditions: 32A60-H8VG wheel, 8-inch diam, ½ inch wide, run at 6000 fpm; 750-ipm traverse speed, 0.050-inch unit crossfeed after each traverse, and 0.001-inch unit downfeed after each complete crossfeed.

materials are ground. It will simplify matters to consider this aspect separately for each group of materials having distinct grinding characteristics.

When the wheel bond is rubber or resinoid instead of vitrified, the wheel does not wear as fast in a wet as in a dry operation. This effect is not limited to a particular group of work materials. This is because the water-base fluid reduces the temperature of the wheel in the vicinity of grinding contact with the result that the organic bond is not weakened as much by heat and the wheel lasts longer. Examples of this effect are provided by abrasive cutoff wheels as well as by resinoid-bond diamond wheels used for the grinding of cemented carbide tools.

Heat-Treatable Steels

Effects of Dry Grinding: When steels other than the austenitic stainless varieties* are ground dry with vitrified-bond wheels, the wheel wear is considerably less than when they are ground with water-base fluids, and the grinding ratios are correspondingly higher. This is illustrated in TABLE 1 by the results of some surface-grinding tests performed on hardened high-speed steels[1]. The fluid was a 1:80 mixture of a widely used general-purpose soluble oil in water, and the wheel specification was 32A60-H8VG, such as is often used for low-grindability tool steels. The grinding ratios are two or three times higher for dry grinding than for wet. It may be that the greater wheel wear associated with wet grinding is caused by the greater thermal shock to which the vitrified bond is repeatedly subjected in the region of grinding contact.

Although comparable data are not available for grinding oils, other tests have shown that the grinding ratios are many times higher when oils are used than when the operation is performed dry. Thus dry grinding is more closely related to ordinary wet grinding than either is to oil grinding.

Contrary to a widely held belief, dry grinding does not necessarily generate more heat than does wet grinding with the same wheel. For example, it has already been mentioned that the depth of burn, which is an excellent measure of the heat generated, was found to be the same in a severely ground hardened high-speed steel (AISI Type T1) whether it was ground wet or dry. Likewise, it can be deduced from studies of residual grinding stresses in hardened AISI 52100 steel that the amount of heat generated was not significantly affected by changing from wet to dry grinding[2].

Under some conditions, less heat will be generated when the work is ground dry. This is illustrated by the surface-grinding tests upon which TABLE 1 is based. A change from a wet to a dry operation resulted in a decrease of 24 percent in the net power input for steel M2 and of 13 percent for steel M3. In these particular cases, changing to dry grinding reduced not only the wheel wear but also the amount of heat generated.

Even though the instantaneous temperature at the point of grinding contact is no higher for dry grinding, this does not mean that the same will be true of the average temperature of the work after an appreciable amount of stock removal. This temperature will depend on the rate of heat extraction relative to the rate of heat generation, and it may rise excessively if dry grinding is done with the same wheel as is satisfactory for wet grinding since air is such a poor coolant compared to water. It is to minimize this temperature rise that softer wheels are generally specified for dry grinding than those usually used for wet grinding.

Water-Base Fluids: The particular type of water-base grinding fluid that is used has far less effect on the grinding ratio than does a change from some water-base fluid to air or to a grinding oil. For example, surface-grinding tests performed on hardened M4 high-speed steel, in which half a dozen distinct varieties of water-base grinding fluids were evaluated, resulted in grinding ratios that

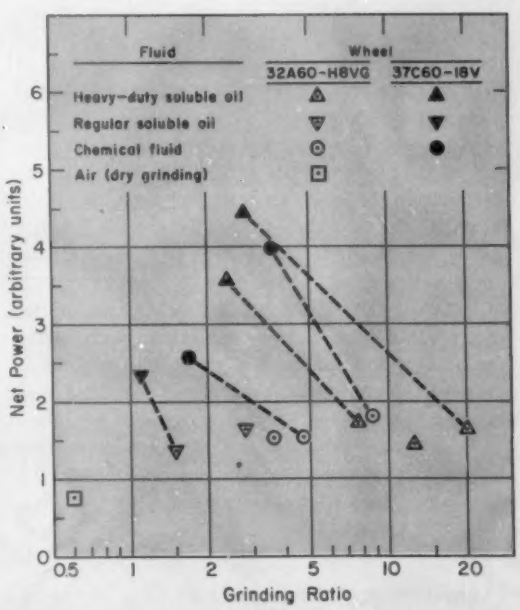


Fig. 1. Grinding performance of various fluids for 302 stainless steel surface-ground with an aluminum oxide or a silicon carbide wheel. Points corresponding to the same fluid are connected by broken lines. Feeds and speeds were the same as in Table 1.

*These will be considered separately because they respond in a different manner to water-base fluids. The well-known 18-8 stainless is the most commonly used of the austenitic group.

[1]References are listed at end of article.

varied only between 0.6 and 0.9. The highest value was obtained with the conventional soluble oil used in the tests shown in TABLE 1.

A similar increase, on a percentage basis, has been found in cylindrical-grinding tests on a hardened tool steel (AISI Type 02) when a transparent emulsion, high in detergent action but low in lubricating power, was replaced by an opaque emulsion with considerable lubricity but low detergency[3]. The grinding ratio increased from 22 to 30 when the concentration of the compound in water was 1:40; and it increased from 31 to 44 when the concentration was 1:10. This example also shows that an increase in the concentration of a water-base fluid can raise the grinding ratio to a moderate extent when ordinary steels are ground.

Table 2—Typical Analyses of Several High-Temperature Alloys

Alloy	Fe	Major Alloying Elements (%) Ni	Co	Cr	Mo	W
A-286	55	25	-	15	-	-
M-252	-	54	10	19	10	-
J-1570	-	29	37	20	-	7
X-40	-	11	55	25	-	7
X-63	-	10	60	22	6	-

Another instance of the effect of concentration[4] is furnished by some cylindrical-grinding tests on AISI 81B45 steel heat treated to a hardness of R_C50. The grinding ratio increased from 90 to 150 as the concentration of a chemical solution was raised from 0 to 4 percent. This change was accompanied by small decreases in the power consumption and in the surface roughness.

Even though changing the type of water-base fluid or its concentration may make a measurable difference in the grinding ratio for these and similar steels, the difference is usually not big enough to be a significant factor in the selection of a suitable grinding fluid. Other factors than the grinding ratio, involving the service properties of the fluid, are likely to be more important. Quantitative data are lacking for similar steels at lower hardness levels, but practical experience indicates that the same conclusion is also applicable to them. There is some evidence that heavy-duty soluble oils can reduce the wheel loading that may occur when low-carbon steels are ground.

Austenitic Stainless Steels

Importance of Correct Fluid: For austenitic stainless steels the grinding action depends a great deal on the nature of the grinding fluid, as can be seen from the surface-grinding test data for AISI Type 302 stainless steel that are plotted in *Fig.* 1. The various soluble oils and chemical fluids were diluted with water to a concentration of 10 percent of the original except for the soluble oil to the left of the others, which was diluted to a concentration of 1¼ percent. Although a 10 percent concentration is considerably higher than is ordinarily used, it was selected because it has been found that when a grinding fluid has a beneficial effect on the grinding action, the effect generally becomes more pronounced as the concentration is increased.

Since grinding action is improved if the grinding ratio increases while the power consumption remains constant, it follows that the aluminum oxide wheel (32A60-H8VG) performed much better with the heavy-duty soluble oils and one of the chemical fluids than it did with the other fluids. The chemical fluid was actually a hybrid type in that it contained an appreciable amount of soluble oil.

From a practical standpoint, it has long been known that successful fixed-feed grinding of austenitic stainless steels involving water-base fluids requires the use of certain compounds specially developed for the purpose. The great majority of commercially available fluids are unsuitable for this application because they not only result in excessive wheel wear but also permit the wheel to become badly loaded so that the work surface is likely to become smeared and discolored. It is worth noting that the same water-base grinding fluids are likely to be as satisfactory for aluminum alloys as for austenitic stainless steels.

The point at the extreme left of the plot shows how unsatisfactory dry grinding is for these steels. The grinding ratio is considerably smaller than for even the least suitable of the water-base fluids. This is the reverse of that found for other types of steels, as discussed previously. The power consumption for dry grinding would have been considerably higher had it not been for the extremely high wheel wear which made the rate of stock removal much

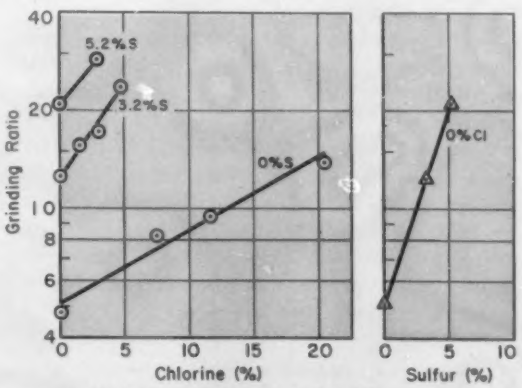


Fig. 2. Variation of the grinding ratio with the sulfur and chlorine content of the grinding oil when form grinding J-1570 (a cobalt-base alloy) with a 32A60-L5VBE type of grinding wheel.

Table 3—Effect of Grinding Fluid on G_V for Several High-Temperature Alloys

Alloy	Sulfo-chlorinated Grinding Oil	Nitrite Solution	Heavy-Duty Soluble Oil
J-1570	30	5.0	3.8
A-286	90	1.7	2.1
M-252	180	5.3	3.9
X-63	250	28	13
302 Stainless Steel	310	1.0	1.2

lower than for wet grinding.

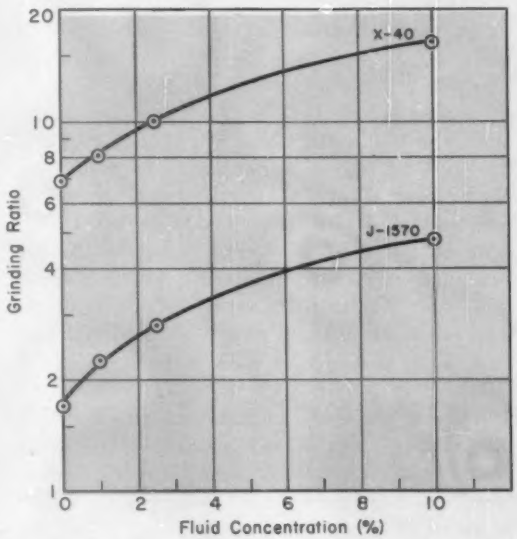
When some of the same fluids were used with a silicon carbide wheel, the grinding ratios were much lower and the power much higher, especially for the heavy-duty soluble oils. This clear-cut inferiority of the silicon carbide wheel may appear puzzling to those familiar with the widespread usage of this abrasive in the past for grinding austenitic stainless steels.

If conventional soluble oils are used, which are perfectly satisfactory for other types of steels, silicon carbide wheels are somewhat superior in precision-grinding operations, especially for the coarser grit sizes. But with the right kind of grinding fluid, aluminum oxide becomes far superior to silicon carbide for grinding austenitic stainless steels. The special soluble oils developed for these steels evidently prevent the occurrence of undesirable surface-chemical reactions with the aluminum oxide abrasive, which result both in loading and in rapid wheel wear. This is an outstanding example of the vital role that the grinding fluid may have in the selection of the proper wheel.

Concentration and Composition: Changing the concentration of the two best heavy-duty soluble oils when the aluminum oxide wheel was used for grinding had a marked effect on the grinding ratio. Increasing the concentration of one of them from 10 to 20 percent caused the grinding ratio to increase from 13 to 25. Likewise, decreasing the concentration of the other from 10 to 2½ percent resulted in a reduction of the grinding ratio from 20 to 8.5. The power was slightly lower at the higher concentration in each case, the decrease amounting to 15 and 9 percent, respectively. When a relatively ineffective chemical fluid was used, the grinding ratio was 3.6 for both the 5 and the 10 percent concentration.

Modification of the composition of the fluid also affected the grinding action of the aluminum oxide wheel. When the fatty acid in an experimental fluid of the chemical type was sulfurized, the grinding ratio increased from 8 to 13. On the other hand, the incorporation of an ionic additive in another chemical fluid had a highly detrimental effect in that the grinding ratio dropped from 3.6 to 1.0. This illustrates how important the exact composition of the grinding fluid can be when the work material is such that the grinding action is strongly influenced by the fluid.

Fig. 3. (below) Effect of the concentration of the grinding fluid on the grinding ratios for two cobalt-base high-temperature alloys. Data are for surface grinding with a 32A60-J8VBE wheel and nitrite rust-inhibitor solution.



Even the highest grinding ratios obtained with water-base fluids were low compared to the value of 360 obtained with a dark and highly active sulfo chlorinated grinding oil. Although a wheel two grades harder was used with the oil than with the water-base fluids (J vs. H), this would account only for a small portion of the observed increase in the grinding ratio. Practically all the improvement can be attributed to the active ingredients in the oil since a similar oil, free from added sulfur and chlorine, resulted in a value of only 22 for the same grinding conditions. However, even this oil exerted some beneficial effect on the grinding action since the grinding ratio obtained with it was several times larger than for the chemical fluids or the regular soluble oils.

High-Temperature Alloys

Used in jet-engine and other applications where high strength is needed at high operating temperatures, high-temperature alloys are also called

super alloys and are either iron-base, cobalt-base or nickel-base, all with substantial amounts of other elements. The alloys in the first group are stainless steels of various types whose high-temperature properties have been significantly improved by increasing the alloy content. The alloys with the best available high-temperature properties are in the nickel-base group. Typical percentages of the major alloying elements are listed in TABLE 2 for the alloys discussed below.

Grinding Oils: As with steels, the grinding ratios are considerably higher when suitable grinding oils are used in place of water-base fluids. The best oils are those high in sulfur, as shown by form-grinding tests on J-1570, a cobalt-base alloy which is more difficult to grind than most of the other high-temperature alloys. In these tests, one or more grooves were ground in a 4-inch-long test block on a reciprocating-table surface grinder with an 8-inch 32A60-L5VBE wheel which had been diamond dressed to a 60-deg V with a 0.030-inch flat. The wheel speed was 6000 fpm, the traverse speed was 450 ipm, and the unit downfeed at the end of each table traverse was 0.002 inch.

When a groove is ground with sloping sides, the grinding ratio is experimentally found to increase with the total downfeed. It is thus necessary to standardize on a constant total downfeed in order to obtain comparable values of G_V, the grinding ratio for form-grinding with a V-shaped wheel. For the total downfeed of 0.060 inch that was used, a mathematical analysis shows that G_V is approximately twice the value of the ordinary grinding ratio G that would have been obtained in a plain surface grinding test. The rounding of the corners of the flat-bottomed V was closely related to the diametral wheel wear and was omitted from the calculation of G_V since this greatly simplified the measurements and calculations without any significant loss of accuracy.

In *Fig.* 2 is shown how the form-grinding ratio G_V for J-1570 varied with the weight percentage of chlorine in the grinding oil for 0, 3.2 and 5.2 percent sulfur content, and also how it varied with sulfur content in the absence of chlorine. Since it required either 2.5 percent sulfur or 13 percent chlorine to produce a grinding ratio of 10, sulfur is seen to be over five times as effective as chlorine in improving the grinding ratio for this alloy. The increase in G_V with increasing chlorine content was greater in the presence of sulfur than in its absence, showing that the two additives were more effective when used together than when used separately.

Not all grinding oils containing sulfur and chlorine would necessarily fall in line with those used in connection with *Fig.* 2, since other factors

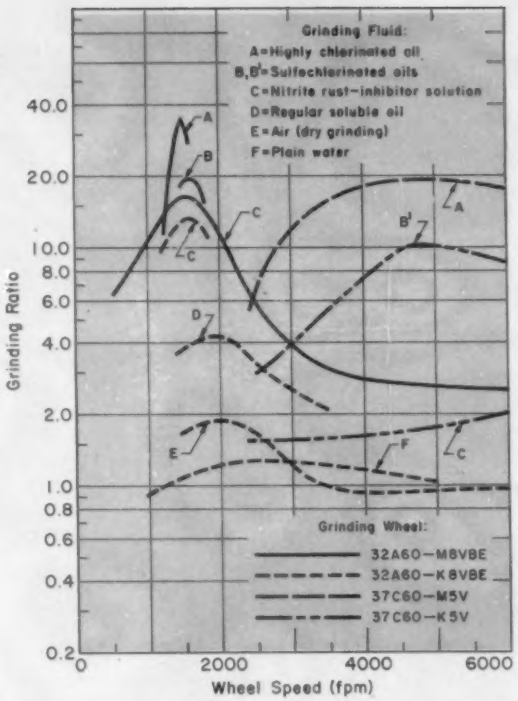


Fig. 4. Effect of wheel speed on the grinding ratio when surface grinding a titanium alloy with aluminum oxide (32A) and silicon carbide (37C) wheels and various types of fluids.

in the formulation of an oil may also affect its performance. These include the viscosity and nature of the grinding oil, the amount of fatty materials, and the form in which sulfur and chlorine are present. Thus a grinding ratio of 30 was obtained with a particularly effective grinding oil for which a value of only 20 was predicted by the results of *Fig.* 2. In another case, the grinding ratio was reduced by 30 percent when the viscosity of the oil was changed from 300 to 120 SSU at 100 F with everything else remaining the same; more important, the lighter oil smoked too badly in this operation to permit its use.

Water-Base Compounds: In parallel form-grinding tests with water-base fluids, the grinding ratios for several high-temperature alloys were far smaller than when a highly effective grinding oil of the transparent sulfo chlorinated type was used, as is evident from TABLE 3. Both of the water-base fluids were diluted to a 10 percent concentration of the original product.

These alloys, as well as 302 stainless, are listed in the order of increasing grinding ratio for the grinding oil, but they fall in an entirely different order with respect to the water-base fluids. For example, the stainless steel is found at either extreme, depending on the type of fluid used.

The relative effectiveness of the two water-base fluids in minimizing wheel wear depended on the alloy, the heavy-duty soluble oil being slightly better in this respect for the two iron-base materials, while the nitrite solution was a little better for the nickel-base and cobalt-base materials. It should also be mentioned that an inactive grinding oil was no better than the nitrite solution for form grinding J-1570, the value of G_V being 5 for both fluids.

The results cited thus far for the high-temperature alloys have all been for a form-grinding operation. Plain surface-grinding tests under the conditions stated in TABLE 1 led to the same general conclusions as to the relative effectiveness of various types of oils and water-base fluids, although the quantitative relationships were usually different. Of the water-base materials, the nitrite solutions gave the highest values of the grinding ratio G.

Slightly to considerably lower values were obtained with other types of water-base products, the best results within this group being associated with some heavy-duty soluble oils; however, the heavy-duty product that performed outstandingly with stainless steel did not show up at all well in grinding a nickel-base alloy.

As is evident from *Fig.* 3, the concentration of the fluid had a considerable effect on the grinding ratio for two cobalt-base alloys, J-1570 and X-40, which differ considerably in grindability. The curves are essentially parallel, which means that the relative improvement in the grinding ratio with increasing concentration was the same for these two alloys. The grinding ratios were lower for plain water than for any of the soluble oils or chemical fluids that were tried, indicating clearly that even the relatively unsuitable products, like regular soluble oils, improved the grinding action of water.

Dry Grinding: When the same two alloys were ground dry, the grinding ratios fell between those for water and the highest concentration of the nitrite solution. The dry-grinding values were 2.1 for J-1570 and 12 for X-40. According to *Fig.* 3, the same grinding ratios would have been obtained at approximately a 1 percent concentration for J-1570 and a 5 percent concentration for X-40.

Thus with these particular alloys, changing from wet to dry surface grinding may change the grinding ratio in either direction, depending on the nature and concentraton of the grinding fluid, and on the grinding conditions. The same is probably true of other high-temperature alloys in view of their similar grinding behavior when other variables are changed. Since the grinding ratio is much higher for wet than for dry grinding when austenitic stainless steel is ground, and the reverse is true for most other steels, the high-temperature alloys can be considered as falling between these two groups of steels in this respect.

Titanium Alloys

Wheel Speeds and Fluids: Titanium alloys cannot be precision ground satisfactorily except with certain types of fluids. Even these may be of little or no value if the wheel speed happens to be wrong for the operation[5]. The extremely wide range of grinding ratios that may be obtained with various types of fluids and at various wheel speeds is shown in *Fig.* 4 for both aluminum oxide and silicon carbide wheels. The results were obtained for one of the original alloys (Ti-150A), which is now obsolete, but they are applicable in principle to any titanium alloy as well as to the commercially pure metal. The curves will be about the same in shape and relative position although their actual locations are known to vary somewhat with the composition of the alloy.

The results plotted in *Fig.* 4 were obtained from surface-grinding tests run at a traverse speed of 450 ipm, the other conditions being the same as in TABLE 1 except for the wheel speed and wheel specifications. The aluminum oxide wheels were satisfactory only at far lower wheel speeds than are normally used. The more effective a fluid was in raising the grinding ratio, the lower was the optimum wheel speed.

The most effective fluid in this respect was a highly chlorinated sulfur-free grinding oil (A), for which the best speed was 1500 fpm, only one-fourth the speed generally used in ordinary precision-grinding operations. An active sulfochlorinated grinding oil (B), which contains much less chlorine, was not nearly as effective. Thus chlorine appears to be a more potent additive than sulfur for grinding titanium alloys, although the reverse was found to be true for the high-temperature alloys. The peak grinding ratio was a little lower for a moderately active oil and considerably lower for an inactive one that was inferior even to some soluble oils.

Only one type of water-base fluid turned out to be really effective in reducing wheel wear, and this was the nitrite rust-inhibitor solution. The results obtained with a solution containing 10 percent of the concentrated product (or about 4 percent of sodium nitrite) are shown by the two curves marked C, one for the grade M wheel used with the oils, the other for a wheel two grades softer.

This difference in grade had only a minor effect on the grinding ratio. Both regular and heavy-duty soluble oils, all tested at 10 percent concentrations, resulted in far lower grinding ratios. Curve D is for the soluble oil that gave the highest

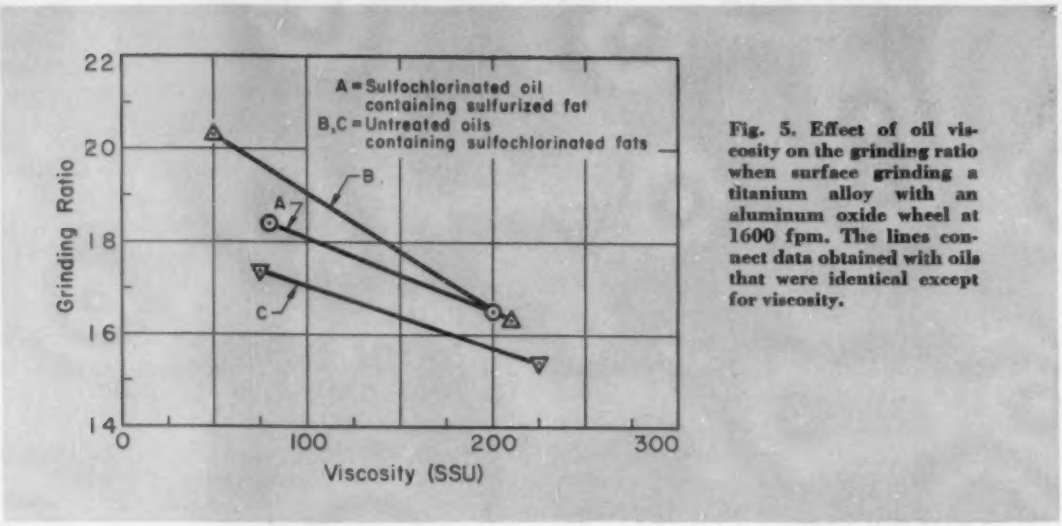


Fig. 5. Effect of oil viscosity on the grinding ratio when surface grinding a titanium alloy with an aluminum oxide wheel at 1600 fpm. The lines connect data obtained with oils that were identical except for viscosity.

values for this type of fluid.

The grinding ratios obtained with other soluble oils fell below this curve, with some of them approaching curve E for dry grinding. Plain water, curve F, gave the poorest results except when the wheel speed exceeded 3000 fpm, in which case water was slightly superior to air. Reducing the concentrations of the water-base fluids likewise reduced the grinding ratios, just as it did for the high-temperature alloys.

Thus from the standpoint of wheel wear alone, dry grinding of titanium alloys is inferior to wet unless the grinding fluid is extremely poor. Another reason for avoiding dry precision operations is that the finished surface is likely to be unacceptable because it is badly smeared.

Surface Chemistry: The unusual way in which the grinding ratio varied with wheel speed was caused by a surface-chemical reaction between the abrasive grain and the freshly formed titanium surface at the point of grinding contact. As the wheel speed was reduced, the contact temperature dropped so that the attritious wear arising from this cause proceeded more slowly. With lower wheel speed, there was also more time for the grinding fluid to form a contaminating film of molecular dimensions on the metal and abrasive surfaces, which further decreased the attritious wear.

The effectiveness of a fluid in minimizing this wear depended on how thoroughly it was able to wet and hence to coat the surface so as to prevent the metal and abrasive from coming in direct contact even though chips were being cut out. At the same time, wear from grain fracture increased as the wheel speed was reduced, and finally it became too great to be compensated for by the reduction in attritious wear. Thus the grinding ratio first rose with decreasing wheel speed, when the attritious wear was decreasing rapidly and the fracture wear was increasing slowly, and then it dropped when fracture wear became predominant.

The effectiveness of sulfur or chlorine in raising the grinding ratio is due to the formation of a sulfide or chloride film on the titanium surface. A sodium nitrite solution, on the other hand, is believed to form a layer of nitrite ions on the titanium surface and a layer of sodium ions on the aluminum oxide surface[6]. According to this theory, the degree of protection furnished by these layers depends on how well the ions fit the atoms on the surface to which they are attached.

Potassium nitrite, used in some grinding compounds for titanium, has been found to result in a somewhat higher grinding ratio than is obtained with sodium nitrite in a solution of equivalent strength. This is explained by the **fact** that the oxygen ions in aluminum oxide, to which the metallic ions adhere, are matched more closely in size by potassium than by sodium ions, so that the surface of the abrasive grain is more thoroughly protected by the former.

The superiority of potassium over sodium ions in this respect has been found to hold not only for titanium alloys but also for high-temperature alloys and for high-vanadium high-speed steels. In several instances, the improvement in the grinding ratio was of the order of 20 percent.

Type of Abrasive: The behavior of silicon carbide wheels differed from that of the aluminum oxide ones in that the optimum wheel speed was in the range of 4000 to 6000 fpm and all the water-base fluids, including the nitrite solution, resulted in very low grinding ratios. The only way

that the grinding ratio could be raised to a more satisfactory level (around 6 or 7) when the nitrite solution was used was to go to a finer grit silicon carbide wheel, in the range of 80 to 120 grit.

Although the grinding ratio is lower for a silicon carbide wheel than for a comparable one in aluminum oxide when a grinding oil is used, it is still high enough to be satisfactory. The advantage of being able to use silicon carbide wheels is that a satisfactory wheel speed for this abrasive, between 4000 and 6000 fpm, is easy to obtain, and it is not necessary to make substantial changes in the equipment in order to get the very low speeds required by aluminum oxide wheels.

Unfortunately, an intense spark stream and a heavy oil mist are both generated when titanium is ground at 4000 fpm and higher, and the fire hazard is considered to be great enough that little titanium is ground with silicon carbide wheels and a grinding oil. At low wheel speeds, there is neither a spark stream nor an oil mist, and there is no likelihood of a fire from the operation itself.

Oil Viscosity: When a grinding oil was used for surface grinding with an aluminum oxide wheel operating at 1600 fpm, the grinding ratio decreased with an increase in viscosity, as shown in *Fig.* 5 for three oils, each made up to two viscosity levels by using blending oils of different viscosity. The effect of viscosity on the grinding ratio in these surface-grinding tests was just the opposite of that found in the previously mentioned form-grinding tests involving a cobalt-base high-temperature alloy.

In the case of titanium, a possible explanation of the observed effect is that a lower-viscosity oil permitted the chemically active fatty compounds suspended in it to be released more readily so that they could wet and contaminate the metal and abrasive surfaces more effectively and thus lead to a higher grinding ratio. On the other hand, when the cobalt-base alloy was ground, the lower-viscosity oil was unable to withstand the heat generated in the form-grinding operation, as evidenced by the heavy smoke, and hence was not as effective in preventing wheel wear as was the higher-viscosity oil.

Titanium is not unique in its grinding characteristics, for it has been found that certain other newly developed metals like zirconium, uranium and beryllium, as well as the alloys based upon them, behave in the same general manner and for similar reasons. For example, by changing to the right type of grinding fluid and reducing the wheel speed to 3500 fpm it was possible to increase the grinding ratio of pure, soft zirconium by a factor of several hundred and also to replace badly smeared surface by an excellent ground finish[7]. In another instance, similar changes in the grinding fluid and wheel speed made it possible to increase the production rate eightfold when surface grinding thin strips of a zirconium alloy, which warped badly when ground conventionally. These things could not be accomplished by changing either the fluid or the wheel speed alone.

The final section of this series of articles will deal with the selection and use of grinding fluids.

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Paramount Problem: Paperwork

Engineering divisions of industry could well use a blueprint to find their way out of the maze of records that is blocking efficiency and increasing costs. That's one conclusion of a survey conducted by Charles Bruning Co., Inc., manufacturer of copying machines, drawing materials and related products.

The survey—which queried the executives of 500 companies—revealed that filing and storage of engineering drawings is the paramount problem in this area. Each respondent expressed some dissatisfaction with the efficiency of paperwork handling and more than 50 percent indicated that they wanted to take steps to improve reproduction systems. Right now, filing and storage stand as the biggest single obstacle to streamlined operations.

Microfilming and the resultant miniaturization seemed, to 56.4 percent of the respondents, to be the best method of realizing cost savings. Diazotype whiteprint process was the preferred reproduction technique and paper the preferred drawing media.

PUNCHED TAPE CONTROLS ASSEMBLY

—reading speed times operations

Tape control of a tire-building machine eliminates the need for the operator to program the machine manually by means of pushbuttons. Quantity of output is increased, quality improved and less operator fatigue results.

ASSEMBLING a tire requires starting with the innermost layer, and successively adding layers until the final outermost layer has been attached. The result—called a "green tire"—is then sent on to the curing stages. A typical machine used for this assembly operation is shown in *Fig.* 1. It consists principally of a small stock of tire-building materials, a large rotating turret containing spools and reels of cord, rubber and so forth, and a rotating drum assembly upon which the carcass is built. The drum, shown in *Fig.* 2, is expanded for work, contracted for withdrawal, and is mounted on the drive unit in front of the operator.

To build a tire, the machine operator draws materials from his revolving supply as he needs them, and rotates the drum to wrap material onto the carcass, layer by layer. Since the material is conveniently arranged at hand, and since the drum is powered, the result is an efficient machine that can produce a variety of types and sizes of tires with little or no changeover. Engineers at B. F. Goodrich Tire Company felt the entire operation could be improved by putting a control on the machine that would save the operator from having to manipulate pushbuttons, levers and foot treadles to actuate the various machine functions. Essentially, the type of control required was a sequence control, but with some stringent limitations. The controller had to be capable of accepting changes in operation sequence, changes in the number of operations, changes in the time required for an operation. Furthermore, the controller had to tolerate interruptions, to allow stopping to correct mistakes, to correct for defective stock or to refill positions on the material supply turret as the need for intervention arose.

Control System: The control system devised to satisfy the changing assembly conditions uses punched tape as the control information medium, tape reader speed as the timer and tape codes to trigger on-off functions as required. Circuits in the control system are designed so that they "latch"—once they receive a signal they remain in operation until another, different signal turns them off. For a circuit associated with any given function, two tape codes are thus required, one to turn on the function, the other to turn it off. For the eighteen functions required in tire building, thirty-six tape codes are used. On the seven channel tape used in the system, any transverse line of tape can contain up to seven holes. One position is reserved for parity check, leaving six spots available for code information.

Timing of operations is controlled by using the tape reading speed as a built-in clock in the control system. The reading speed is ten codes (or transverse lines) per second, so that any operation can be controlled to intervals as fine as 0.1 second. A duration of time can be measured as a length of tape. Since the tape travels at one inch per second, timing any operation is relatively straightforward. For example, if a controlled operation is to last exactly 36 seconds, the actuating code is placed 36 inches ahead of the turn-off code. The actuating code would be punched on the tape, followed by 36 inches of tape containing nothing but sprocket holes, and then finally, the turn-off code. Once a

Fig. 1. Operator attaches white sidewall to tire carcass. Large turret, containing tire components, is indexed under tape control.

tape for a specific tire has been made, it is spliced as a continuous loop so that the operator can build tire after tire with no attention to the controller or tape reader. The time dimensions of the tape are easily changed when needed—splicing in a length increases time, chopping out a length shortens duration of an operation. Actual production experience with the control system reveals that this programming flexibility is helpful in matching the operation to the natural rhythm of a tire building operator.

Operation: To prepare a tape, the functions required to build a given tire are first listed in order. The on-off codes associated with each function are then punched into the tape, separated by a tape length corresponding to the time that the function must operate. An adding machine with coupled tape punch and reader is used as the tape preparation unit. A counter on top of the unit displays the length of tape being punched, measured from the beginning of the tape. In this fashion, the engineer preparing the tape establishes the sequence of operations, the time that each shall last and over-all cycle time. The tape speed is also convenient for the use of the time study staff, since their measuring units are commensurate with the tape—0.01 minute equals 6 lines of tape. The reader incorporated in the tape preparation unit enables automatic production of duplicate tapes from a master.

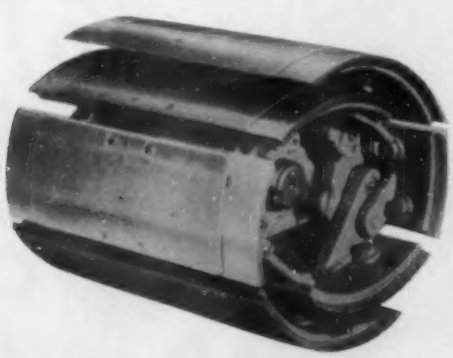


Fig. 2. Expandable drum serves as foundation for building a tire carcass. Tape controls the expanding and collapsing movements, three speeds forward and three speeds reverse for assembling the tire.

Fig. 3. Completed tire carcass consists of many different components placed in careful arrangement during assembly operations.

At the machine, the tape-assisted tire building begins when the operator places the tape in the controller. The main components of the tire assembly, *Fig.* 3, are the liner, plies, bead, tread and finishing strips. In putting these components together to form the tire, the principal machine movements are rotate drum (three forward and reverse speeds), brake drum, operate stitchers, operate rollers, operate bead cylinder and index turret. At the start, the drum is in collapsed condition on the drive. By braking the drum and driving it simultaneously, the drum is expanded. The turret indexes to present the liner material and the operator attaches one end of the material to the drum. The drum then rotates at low speed and stops. The operator cuts the trailing edge of the liner and splices it to the leading edge.

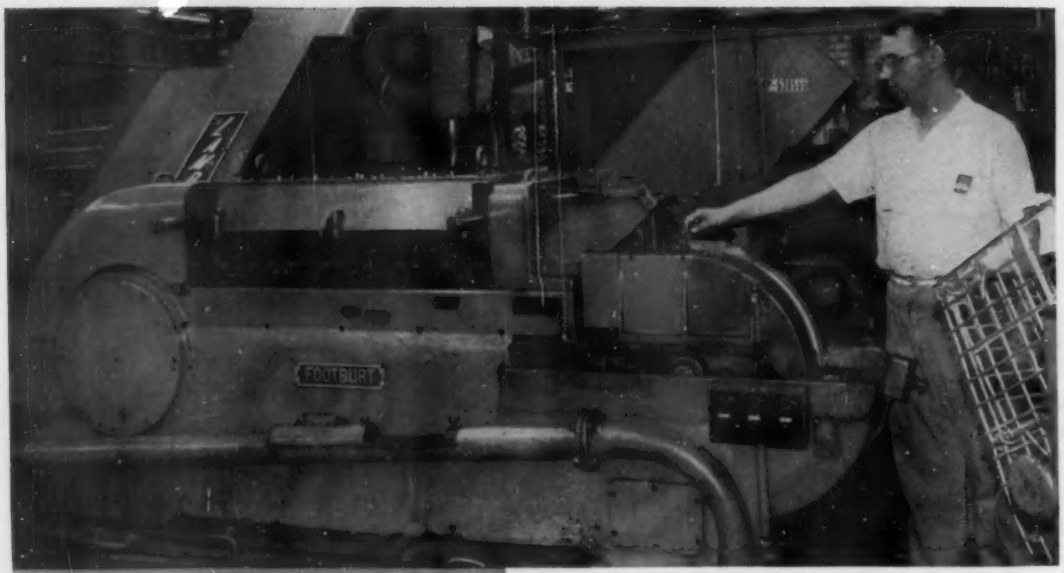
Subsequent layers are assembled in roughly the same fashion—the tape indexing the material turret, controlling the drum rotation and other actions, until the finish strip is placed on the carcass. After the final strip is applied, the drum drive motor shifts to high reverse speed as the brake is operated and the drum collapses. The operator then removes the finished green tire and sets up for the next unit. The tape, being spliced in a continuous loop, is also in position to start the next tire.

Man-Machine Relations: Assembly is one of the most difficult of production jobs to automate and control, except for the high-production items of relative mechanical simplicity where the control system is of the fixed program type. To assemble a variety of product types, the tire assembly control uses a flexible program system—it can change the sequence and amount of components, change the number of operations, change the time required for an operation and stop at any time to allow manual intervention. This flexibility was achieved by orienting both machine and control design around the operator. The man builds the tires, the machine and control assist. Musclepower is supplied by the machine and its actuators, simple decisions and timing by the controller. The operator provides skill and responsibility. Even the tape, the flexible program, is carefully constructed and reworked to match the speed of the machine to the natural rhythmic motion of the tirebuilder. By designing the system to utilize the best of the human capabilities and relegate lesser functions to the machine and control, the system is both optimum and flexible. The result is better quality, more tires produced and much less fatigue for the operator.

"Harford, would you mind not bearing down so hard on your next drawing?"

TOOLS at work

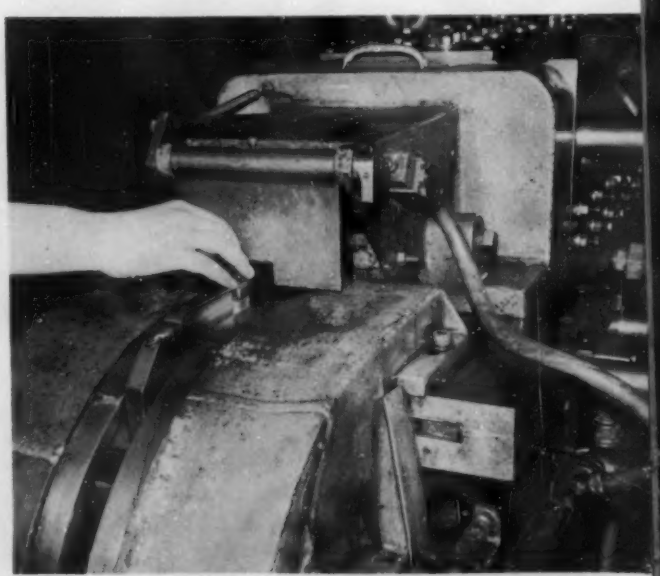
TURBINE BLADES are forged with a 16,000-lb steam accelerated forging hammer at Westinghouse Electric Corp.'s Lester, Pa. plant. The machine is used to make 40 to 44-inch long blades and is capable of forging blades as long as 50 inches. Velocity of the ram at point of strike is 25 fps. Operating speed is up to 60 spm. The anvil of the Erie Forging Co. machine measures 7 by 13 feet. A special building houses the forge, a steam accumulator, a walking-beam gas furnace and a conveyorized salt bath furnace—all required for the forging hammer facility. When in continuous operation, the forge uses about 9000 lb per hour of 110-psig steam.



CONTINUOUS-FEED BROACH machines governor valves at Ford Motor Co.'s Sharonville plant. The Foote-Burt broach has a removable tunnel head with adjustable tapered gibs to position the broaches accurately. Broach length within the tunnel head is 40 inches. The tunnel head holds 12 broach sections: four on each side to broach the bosses and pad and four at the top to broach the end face. A roughing broach, two intermediate stages and a finishing broach make up a set. Broaches are sharpened every 20,000 pieces. Production is 680 parts per hour at 85 percent efficiency. Metal-removal rate is 7 cu in. per min. Mineral oil is used as a coolant and as a lubricant for the broach chain.

GOVERNOR VALVE produced on continuous broaching machine. The valve is of close-grained cast iron, 131-207 Bhn. Tolerances are tight: bosses on two parallel sides of the governor must be within ±0.0025 inch, the end face must be flat within 0.0005 inch and the rectangular pad on the side of the part must be machined to a location tolerance of ±0.0025 inch. Fifty-microinch surface finishes are required.

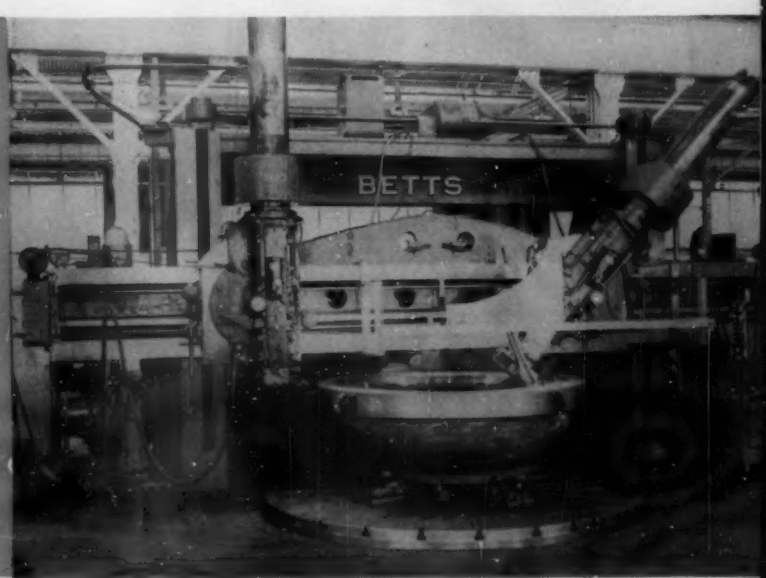
OPERATOR drops governor valves into each of the six fixtures on the continuous broaching machine as they pass by. Location and clamping are automatic. An end stop pin at the fixture bottom establishes the part position and lateral walls center the valve body in the fixture. As the chain advances, a cam-activated lever automatically closes two V's around the OD, clamping the part rigidly to resist broaching forces. Swinging gates at the tunnel mouth detect improperly clamped workpieces to stop the machine instantly.



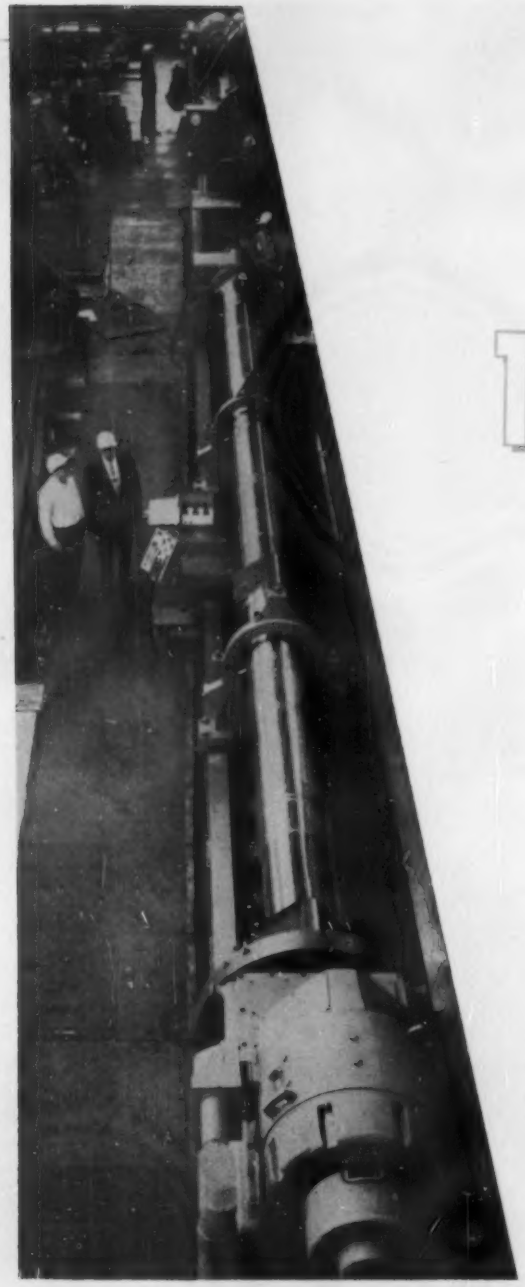
THIS MACHINING CENTER utilizes the "slugging" principle to swiftly convert bar stock into finished components. The machines—automatic bandsaw, single-spindle power-feed drill press and a Warner & Swasey single-spindle automatic chucker—are arranged for convenient access by the operator. The bar stock first is cut into slugs on the bandsaw, then drilled out where required on the drill press and moved to the chucker for complete machining. The operation is at General Electric's Locomotive & Car Equipment Dept., Erie, Pa. The compact layout eliminates the usual delays and expense of intermachine workpiece transportation. Use of the bandsaw eliminates the need for a cutoff operation on the chucker. Material savings up to 26 percent result, since the saw kerf is $\frac{1}{16}$ inch wide, as compared to the $\frac{1}{4}$ to $\frac{3}{8}$ inch required with standard lathe parting tools.

TOOLS at work

ONE OF THE LARGEST explosive formed parts being fabricated at the Ryan Aeronautical Co.'s Aerospace Div. is a 78-inch diameter, 22-inch deep parabolic missile reflector. The 22-ton die used in forming this part was machined from a single ductile iron casting, Type 80-60-3 pearlite. Machining tolerances were 0.002 inch. Machining was accomplished on this Betts vertical boring mill using a Mimik hydraulic tracer attachment. The tracing template is visible above the die. Pouring and machining were accomplished at National Supply Corp., Los Angeles.



TOOLS at work



FORGINGS up to 65 feet long can be machined on this lathe, which is shown here turning a 45-foot long shaft. About 13,000 lb of steel will be removed from the rough forging, making the finished weight of the shaft 41,000 lb. The rough forging was made from a 110,000-lb ingot of electric furnace vacuum degassed steel. The Farrel-Betts lathe is equipped with electronic controls for feeds, speed and threading. There is no leadscrew. The operation is at A. Finkl & Sons Co., Chicago.

Fig. 1. Aluminum plates welded by explosive force. Weld was effected by direct exposure of disks to explosive force.

WELDING and JOINING

new applications of explosives

By L. Zernow
I. Lieberman
W. L. Kincheloe

Ordnance Division
Aerojet General Corp.
Downey, Calif.

Explosives are well established sources of power in metal-forming applications. Research shows that they are also adaptable to welding and joining. The author explains the theory of their use and the tooling required in these fields.

WITHIN THE PAST FEW YEARS explosive forming has become a familiar and useful tool. Its most valuable applications have been related to problems in which improved quality, shortened lead time and reduced capital investment are required. In these applications it owes its present competitive position to its ability to accomplish jobs that can be done only with difficulty by pressworking.

It is now possible to utilize explosive energy in two entirely different processes—welding and joining. Although the work performed to date has been limited in scope, the potential of explosive welding and joining is well established and these processes will undoubtedly play important roles in future industrial and Space Age applications.

Welding Theory: Theoretically, it would be possible to place two clean metallic surfaces into such intimate contact that the cohesive forces between the atoms would be sufficient to hold them together. This might be accomplished with two similarly oriented single crystals by joining them at a perfect joint cleavage face. If the faces were perfectly clean and plane, the strength of the joint would be as good as that of the parent metal. In this case, no force would be required to effect a perfect joint. This condition can be realized only in theory, because perfect planarity of cleavage faces is impossible to obtain. Moreover, the degree of cleanliness required is attainable only under the most stringent laboratory conditions. In addition, the polycrystalline structure of most materials cannot be readily matched between opposed surfaces in materials of any type.

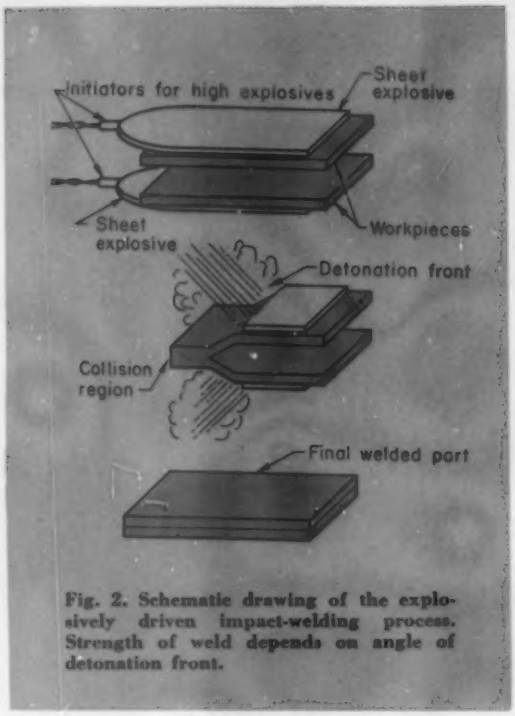


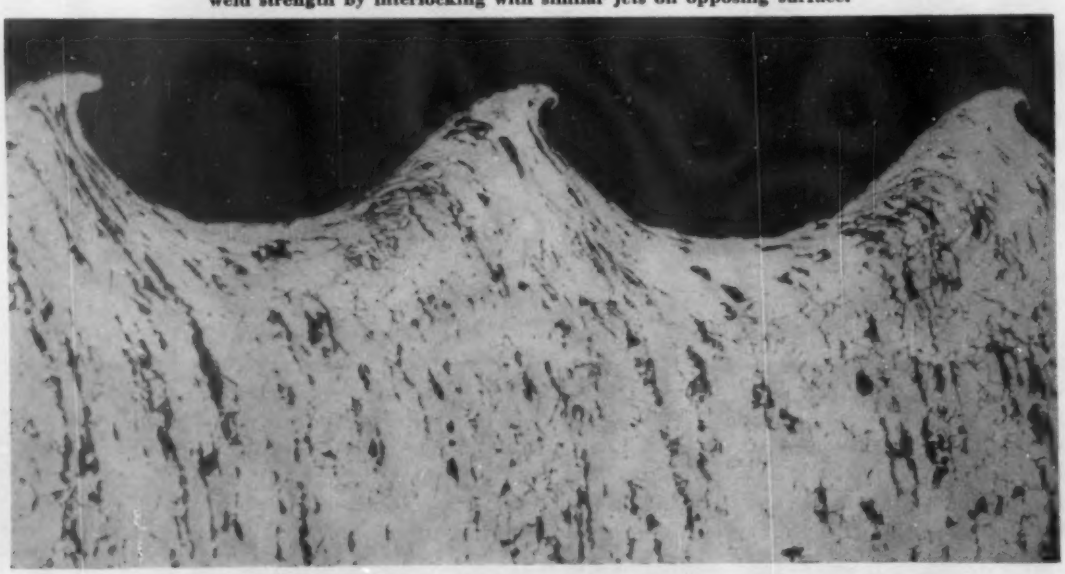
Fig. 2. Schematic drawing of the explosively driven impact-welding process. Strength of weld depends on angle of detonation front.

The presence of surface irregularities suggests that high pressure on both surfaces would be useful in compressing high spots and thereby increasing surface contact. Similarily, if two surfaces are slid over each other in a shearing motion, high spots will be eroded and surface contact increased. If both processes—pressing and sliding—are carried out simultaneously, there are substantial temperature rises at the faces. These rises are caused by compressed trapped gases, bulk compression and friction. If the processes are continued for a sufficient period of time, the surfaces melt and a rudimentary fusion weld is effected. However, because of the trapped gases, oxides and organic surface impurities, it is impossible for the weld to attain an ultimate level of strength.

Cohesion of two surfaces under these conditions is not always indicative of a true weld. For example, the sliding action of two surfaces under pressure causes a certain amount of interlocking between opposed sets of deformed surface roughness peaks. In addition, even if temperature rises do not reach the welding point, they may reach the sintering point, in which case atomic diffusion processes can build up at the contact area.

It is evident that explosive welding requires plastic deformation of the opposed surfaces. Therefore, an explosive charge can be utilized to accomplish welding either by subjecting the bond interface to a very high normal force, *Fig.* 1, or by causing a sudden shear between the two surfaces under pressure. A convenient way to accomplish the explosive welding process is to project the two pieces so they impact at high velocity. This virtually assures plastic deformation and also permits control of the shear components by the geometrical aspects of the collision. An example of this method is seen in *Fig.* 2 in which two identical strips of metal are cleaned and placed in parallel planes. Appropriate amounts of sheer explosive are placed on the outside surfaces of each strip and detonated simultaneously.

Fig. 3. Eruption of surface jets on a steel projectile. These increase weld strength by interlocking with similar jets on opposing surface.



As a result, the two strips of metal are projected toward each other and collide. If the amount of explosive and the spacing have been correctly selected, the two metal strips will be welded to each other. Factors of spacing and explosive are critical since, if they are not maintained correctly, spalling will occur.

An interesting and highly useful phenomenon that occurs during the explosion is the eruption of microscopic swirls on the interface surfaces, *Fig.* 3. These are called jets and they contribute greatly to the weld strength by their interlocking nature. Surface jetting from flat plates, however, is dependent upon the angle at which the plates come together. It is possible to obtain jet-free surfaces in some materials if the impact angles are less than the critical angles defined by the shock properties of the colliding materials.

To date, explosive welding experiments have been carried out with aluminum, aluminum alloys and low-carbon steel. Although the process is applicable to dissimilar metals, it is necessary to consider specific shock properties of both metals when establishing operating conditions.

In evaluating explosive welding, it is evident that this process can be considered a form of cold welding. Because only the local interface region reaches welding temperature, the effects of heat treatment should not be lost and shrinkage problems should be minimal. However, because the process is still in the early research stages, there is as yet little quantitative data available regarding these factors, although enough is known to indicate that the process is very practical.

Explosive Joining: Explosive joining can be distinguished from explosive welding by the nature of the bond. Explosive welding results in a fused interlocking bond: explosive joining provides a frictional or mechanical bond, *Fig.* 4. In joints of this type, an elastic strain in the mating area puts the fibers of the outer cylinder in compression and those of the inner cylinder in tension. The normal forces on the joint surfaces and the total frictional forces resisting separation will be dependent on the materials being joined. The effective coefficient of friction can be increased by appropriate preparation of the surfaces forming the interface. Thus, scoring and knurling contribute appreciably to joint strength by creating a keying effect that increases the forces resisting separation, *Fig.* 4.

A logical improvement on frictional and keyed joints would be the mating corrugation technique also illustrated in *Fig.* 4. By eliminating the relationship between joint strength and the coefficient of friction, this process would make joint strength entirely dependent upon the physical properties of the material being joined.

Relatively simple tooling would be required to effect joints by explosive forming. The three types discussed could easily be fabricated by enclosing the two prepared pipe ends in an exterior die and

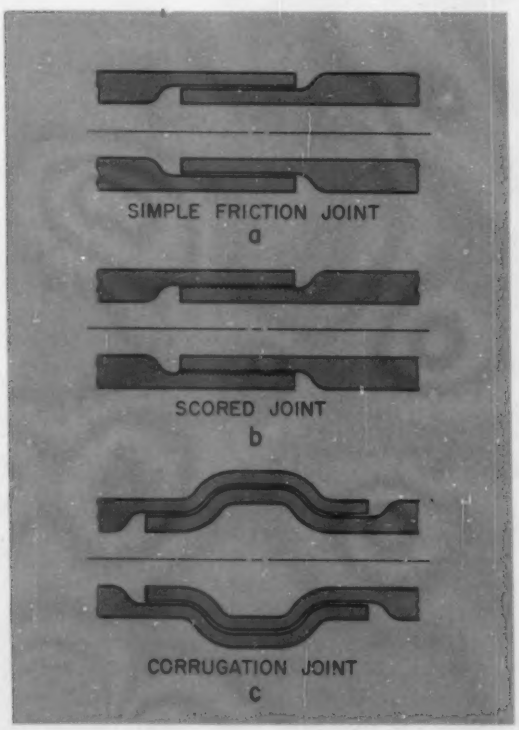
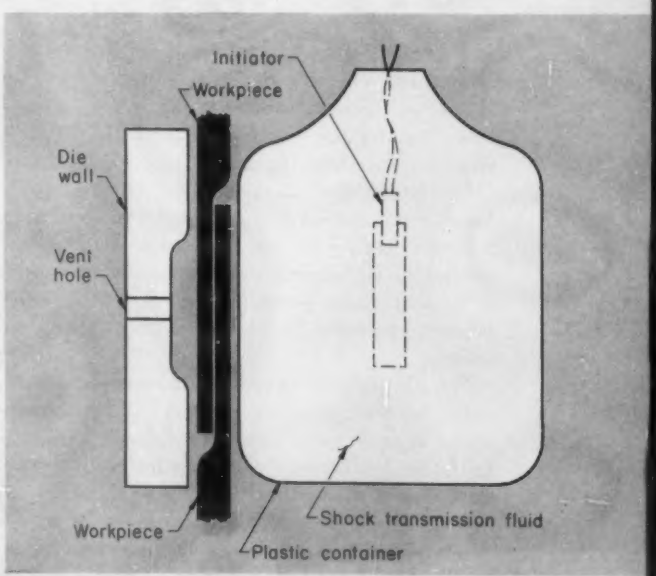


Fig. 4. (left) Three types of explosively formed joints. Corrugation eliminates friction as a primary holding force.

Fig. 5. (below) Schematic drawing of the materials required to explosively form a corrugation joint.



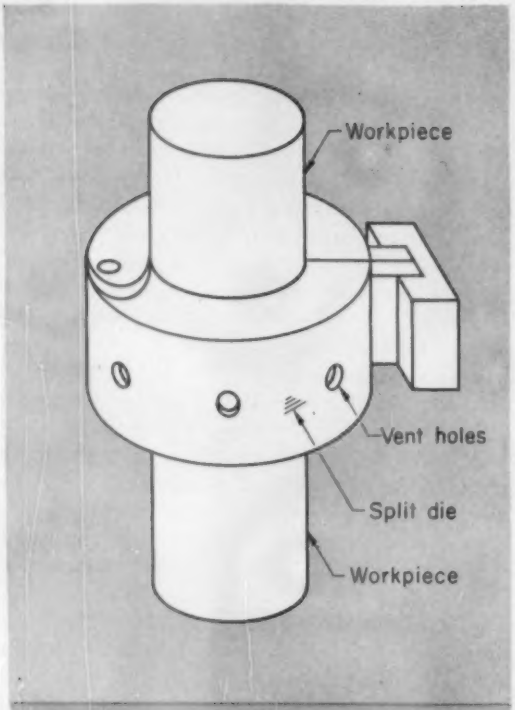


Fig. 6. Simple segmented die for forming corrugated joint. Hinged die blocks are necessary for part removal.

detonating an explosive charge in the interior. A plastic bag of water would contain the explosive and limit the area of application as shown in *Fig.* 5. The die would be of segmented design to facilitate unloading as shown in *Fig.* 6. Modifications of these techniques could be made to solve individual problems of pipe diameter, thickness and length of section. It would also be possible to use an external explosive charge with an internal die. The best system would be one in which no die is used. Systems of this type are possible if pipe ends are modified for this purpose.

The Future: Future prospects for the explosive joining and welding processes are excellent. Explosive joining should have many useful applications in isolated or inaccessible regions where the power and equipment required for conventional welding are not available. Explosive welding should also be useful in similar circumstances. However, modern and future Space Age applications open the most interesting avenues of speculation in regard to explosive welding. In the vacuum of outer space, this technique would be most practical since the dirt-free laboratory conditions required for optimum results are normal beyond the earth's atmosphere. Also significant is the fact that explosive welding eliminates transportation problems resulting from the parasitic weight of conventional equipment.

Radar Measures Target Speed

A new radar system that can measure both range and speed of a moving object among a multitude of stationary objects has been developed by Ford Motor Co.'s Scientific Laboratory. One of the possible uses for the new system may be found in obstacle sensoring equipment for automobiles. Other future applications for the system may be found in equipment to give aircraft pilots a more accurate reading of the distance from wheels to ground during landing, in proximity-fusing systems or in short-range surveillance devices with which infantry can detect personnel movement in wooded terrain.

For all practical purposes, the range-measuring radar is accurate even at very short distances where regular radar runs into difficulty. There is no basic limitation on the method's long-range capabilities. A significant difference between the new system and commercial radar is that it utilizes the Doppler effect caused by the reflection of extremely high-frequency radio signals from a moving target in combination with phase modulation of the transmitter signal, thereby creating two separate signals instead of one. Through comparison of a ratio of the amplitudes of these two audio-frequency signals, the distance between the target and the radar equipment can be obtained.

Target velocity can be obtained in terms of the frequency of either of the two Doppler signals. The relative speed need not be very high since motion of only a fraction of a mile per hour is sufficient for a measurement to be made.

Equipment needed for this system is much simpler than standard radar equipment. The number of microwave components has been reduced to the smallest possible number, and this lowers the expense of the system as well.

This new radar method is an outgrowth of the Ford Scientific Laboratory's fundamental studies of temperature, pressure, structure of materials and other basic phenomena which ultimately may lead to new automotive technology.

William Moreland

ASTME President, 1961-62

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ASTME's New Frontier...

Lined up for the press shortly after their election are ASTME's new officers: (left to right) H. Verne Loeppert, David A. Schrom and Philip R. Marsilius, vice presidents; William Moreland, president; Francis J. Sehn, vice president; Albert Underwood, Jr., treasurer; and Arthur Cervenka, secretary.

Moreland Heads Society

WITH THE SERENITY and confidence that is typical of ASTME's new president, William Moreland stepped to the podium on May 24 and accepted the top position in the 41,000-member American Society of Tool and Manufacturing Engineers.

Some 300 persons were gathered at ASTME's Annual Banquet in New York's Statler Hilton Hotel to see retiring President H. Dale Long turn over the reins of the Society to his successor and install the other national officers elected by the Board of Directors: David A. Schrom, Philip R. Marsilius, H. Verne Loeppert and Francis J. Sehn, vice presidents; Albert Underwood, Jr., treasurer; and Arthur Cervenka, secretary.

President Moreland, who is chief manufacturing executive at The F. E. Myers & Bro. Co., Ashland, Ohio, easily assumed the key role in the Society and in the evening's ceremonies. As his first official act, he presented Mr. Long with a large silver bowl, a token of gratitude from the officers and directors for the past president's dedicated service.

Looks to the Future

A staunch supporter of long range planning, President Moreland lost no time in turning the eyes of his audience toward the future:

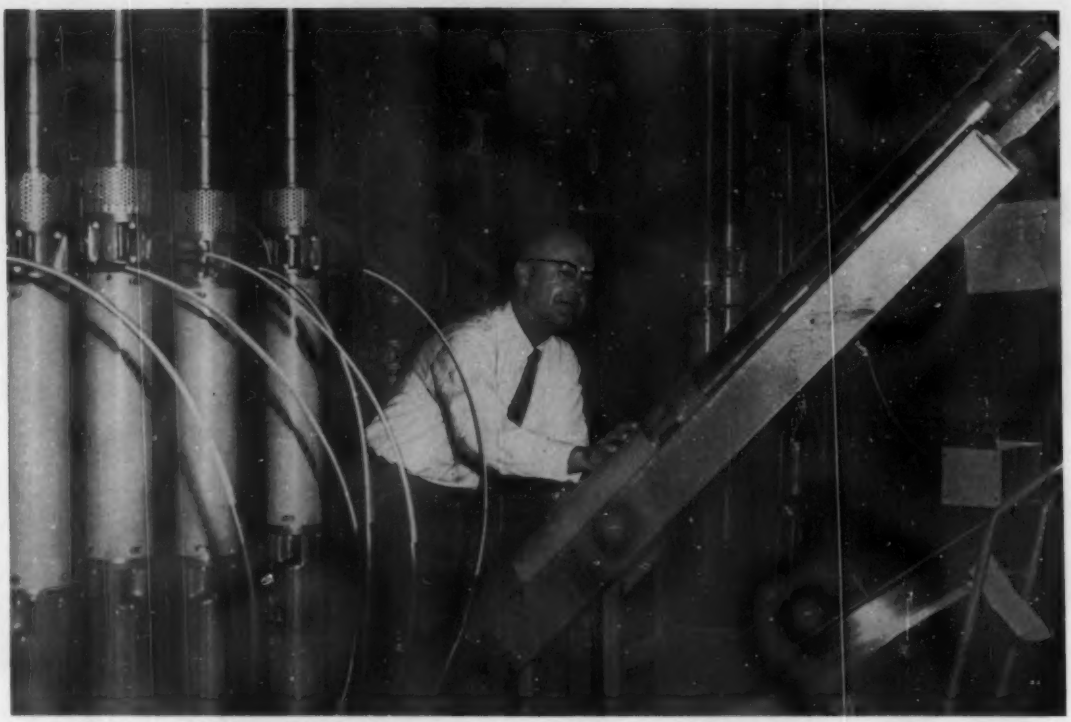
"We, as tool and manufacturing engineers, are being called upon to be in the vanguard of a technological revolution whose accomplishments in the coming years our wildest dreams cannot encompass. Our individual contributions, the effort each and every one of us puts forth, will largely determine whether the tally in 1975 is one of progress or one of decay. . . . The Society during these years intends to pursue every avenue to become the dominant factor in our profession and the world headquarters of manufacturing know-how."

But the new president's approach to long range planning is by no means that of pie-in-the-sky. Only a few days before his election he reminded a group of chapter chairmen of the more down-to-earth aspects of planning ahead.

"The Society cannot now rest and claim progress because it has planned well," he cautioned. "The goals we have set are not ours because we have established them. They will be ours only when we have expended great constructive energy and ingenuity in their attainment."

At 51, William Moreland is more than well acquainted with the organization he now heads. He joined the Society 20 years ago in Detroit and served that chapter in several official capacities. Later, he held various offices in Rockford chapter, including the chairmanship, and is now a charter member of Mansfield Chapter 135.

A board member in his fourth term, he has served as national secretary as well as first, second, third and fourth vice president. He spent 10



Despite his busy schedule as head of the Society and chief manufacturing executive at The F. E. Myers & Bro. Co., William Moreland takes time out to inspect a submersible pump in the company plant.

years on the National Standards Committee, serving one term as chairman, and last year he headed the Director Nominating Committee. Also, he has served on the name-change, officer nominating and policy coordinating committees of the Society.

The Moreland's only child, William, is an electrical engineer in Los Angeles—and came across the country to see his father take the oath of office.

Two Newcomers in Officer Group

Albert Underwood, Jr., and Arthur Cervenka are both newcomers to the national officer group this year. A past chairman of Windsor chapter, Treasurer Underwood is currently serving as the Canadian representative on the Board of Directors. He is quality control manager, Windsor manufacturing operations, Ford Motor Co. of Canada, Ltd.

The new ASTME secretary is manager of equipment and process engineering at Grumman Aircraft and a member of Long Island chapter. Mr. Cervenka, who has chairmanned the National Constitution and Bylaws Committee and served on the National Finance Committee, became a member of the ASTME Board last January to fill the vacancy created by the death of Irving H. Buck.

On May 22, the House of Delegates, the voice of ASTME's 173 chapters, met in closed session in New York and elected 14 men to the 1961-62 Board of Directors. According to constitutional procedure, the fifteenth member of the board will be the immediate past president, H. Dale Long.

On the new board are six directors-elect, who will take office next October at the semiannual meeting in Toronto:

GEORGE C. BENNETT, Framingham Center, Mass. A past chairman of the National Public Relations Committee, George Bennett is manager of field services at Lapointe Machine Tool Co. Besides organizing the Society's Framingham chapter, he was active in the forming of the Long Island group.

RALPH L. CHRISSIE, Los Angeles, Calif. In 1939 Ralph Chrissie joined the Society as a charter member of South Bend chapter. Since that time he has chairmanned the Los Angeles chapter and served three years on both the National Program and Membership committees. He is currently sales engineer at the Arrowsmith Tool & Die Corp.

CARL A. DARGER, Muncie, Ind. Immediate past chairman of the National Finance Committee, Carl Darger has twice presided over the National Membership Committee. He has held several offices in Muncie chapter, including that of chairman, and is the owner of Carl A. Darger & Associates.

ROBERT M. JOHNSON, Minneapolis, Minn. A member of the Society for 15 years, Robert Johnson has served on the National Membership Committee since 1956, spending this past term as chairman. He has also held the chair of Twin Cities chapter

and is supervisor of production engineering for two divisions of Minneapolis-Honeywell.

FREDERICK PREATOR, Logan, Utah. After eight years of membership on the National Education Committee, Frederick Preator last year served that group as consultant. As professor and head of the tool and manufacturing engineering department at Utah State University, he pioneered and developed the curriculum offered by this department of the university.

FRANCIS J. SEHN, Detroit, Mich. Secretary of the Society last year and a vice president this term, Francis Sehn will take the office of director next fall in place of Frank F. Ford, who recently resigned from the board. According to National Procedures, Vice President Sehn fills the vacancy on the incoming board as recipient of the highest number of votes among those candidates not elected by the delegates in New York. A director-elect this year, Mr. Sehn previously served on the board from 1958 to 1960. He is shown with the new officers on Page 81.

Mr. Ford's unexpired term on the current board has been filled by H. Verne Loeppert, newly elected vice president and immediate past treasurer of the Society. Mr. Loeppert is serving as director by virtue of the votes he received from the House of Delegates at their 1960 balloting in Detroit.

Besides the six new members, the 1961-62 board includes eight incumbent directors:

WILLIAM MORELAND, chairman of the board
G. BEN BERLIEN, Oakland, Calif.
DUANE H. BRIGHTON, Peoria, Ill.
ARTHUR CERVENKA, Oakdale, L. I., N. Y.
PHILIP R. MARSILIUS, Bridgeport, Conn.
DEAN F. SAURENMAN, Houston, Tex.
DAVID A. SCHROM, York, Pa.
ALBERT UNDERWOOD, JR., Tecumseh, Ont.

National Committee Heads Named

In addition to the officers and directors, members of another important part of the national family were chosen in New York. Appointed or reappointed to head the national committees this year are 15 men eminently qualified for the job.

These committee chairmen, picked to direct Society activities in the following specific areas, are:

Constitution and Bylaws—Michael Skunda, supervisor of production engineering, AC Spark Plug Div., Flint, Mich.

Editorial—James C. Rodgers, industrial sales manager, Ingersoll Rand Co., Chicago, Ill.

Education—Oliver S. Hulley, education consultant, General Electric Co., New York, N. Y. The vice chairman in charge of professional development is Harry J. Todd, manager of Todd Machinery Co., Salt Lake City, Utah.

Exposition—Arthur Mackmann, chairman and general manager, Franke Gear Works, Chicago, Ill.

Finance—Frank Ritchie, manufacturing manager, Ford Motor Co. of Canada, Ltd., Windsor, Ont.

Honor Awards—Ray H. Morris, president, Ray H. Morris & Co., Inc., West Hartford, Conn.

Judicial—T. Bert Carpenter, president, Bert Carpenter Co., Birmingham, Mich.

Membership—F. Paul Simpson, tool engineering control supervisor, Convair, General Dynamics Div., Fort Worth, Tex.

Program—James R. Matthew, technical staff, Hughes Communications Div., Los Angeles, Calif.

Qualifications Committee — Arthur Cervenka, manager of equipment and process engineering, Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y.

Public Relations—Lawrence A. Wacker, president and general manager, Sterling Tool and Manufacturing, Milwaukee, Wis.

Research—Howard C. McMillen, general manager, Copeland Refrigeration Co., Brantford, Ont., Canada.

Standards—Truman Coy, production engineering manager, New Holland Machinery Div., New Holland, Pa.

Technical Publications—Raymond E. Gariss, senior tool design engineer, Douglas Aircraft Co., Long Beach, Calif.

New Faces on the 1961-62 Board of Directors

George C. Bennett | Ralph L. Chrissie | Carl A. Darger | Robert M. Johnson | Frederick Preator

Exposition and Conference

Draw Record Attendance

RUNNING CONCURRENTLY with the ASTME Engineering Conference last May 22-26, the 1961 Tool Exposition set a new record in attendance. Some 34,420 persons from all parts of the nation and the world turned out for the Exposition's five-day stand at the New York Coliseum. This tops the average daily attendance at last year's 7-day exhibit, which set an all-time high in total attendance.

Spread over three floors of the huge Coliseum, the Exposition told the latest story in creative manufacturing, with more than 5000 machines, tools and accessories as illustrations. Among the 300-plus exhibits, numerical control was far and away the biggest—and most plentiful—attraction.

Sunny weather prevailed during Exposition week in New York, both literally and figuratively. Comments from the exhibitors as well as the high tide of interest among spectators mirrored a fair and clear outlook in the nation's economy. "Judging from what I've seen this week," said one exhibitor, "business conditions must be on the upturn."

Shortly before the Coliseum doors opened to a throng of visitors on opening day, two events marked the commencement of the multimillion dollar exhibit. First, the famed Columbus Circle, where the Coliseum is situated, was by proclamation of the Mayor of New York renamed Tool and Manufacturing Engineers Circle for the week.

An hour before the Exposition opened, some of New York's leading industrialists gathered at an exhibit preview luncheon, the official kickoff for the mammoth display. Speaking to this capacity audience, ASTME Vice President David A. Schrom called attention to the facts of industrial life, with marked emphasis on the relationship between automation and unemployment.

Productivity—output per worker—is the key factor in industrial efficiency, Mr. Schrom pointed out. Higher pay for workers is possible only if productivity per worker is upped. And the only way this productivity can be substantially increased is through automation.

Labor and management must stop fighting each other where automation is concerned, said Mr. Schrom, who is works manager of the York Div. of Borg-Warner Corp. The thing that they are both up against is competition, foreign and domestic, and labor and management must get together so that this competition can be met. Otherwise, individual companies will go out of business—and the jobs they furnish will be gone.

Mr. Schrom pointed out that industry has an obligation to retrain workers who are displaced by automation. He called this a moral obligation that management must assume. And he added that despite the present unemployment situation, seven million jobs went begging last year because there were no adequately trained men to fill them.

Conference Updates Engineers

While the Exposition brought engineers face to face with the newest in manufacturing equipment, the ASTME Engineering Conference, going on simultaneously at New York's Statler Hilton Hotel, provided up-to-the-minute information on new developments in manufacturing.

Highlighting the week-long Conference program were over 50 technical papers, presented by top

men in the field, plus a one-day symposium on material removal and a two-day Surface Metrology Seminar. The technical sessions, which covered everything from powder metallurgy to numerical control and from grinding to operations research, drew nearly 1500 registrants. Like the Exposition visitors, Conference participants seemed most interested in numerical control.

Some 90 engineers turned out for the seminar to hear a dozen experts on surface metrology and to discuss their individual measurement problems with the panel. Speaking at the first session, Arnold W. Young, supervisor of engineering sales at Engis Equipment Co., Chicago, emphasized that manufacturing and the measuring technique must keep pace. "The measuring technique," he said, "must go a step further than merely expressing a method of procedure and instrumentation—it must act as a link in the manufacturing process."

The three Techtours—combined engineering discussions and plant tours—proved to be one of the most popular Conference activities. Tickets for the Techtours at Republic Aviation Corp. and Grumman Aircraft Engineering Corp. were completely sold out even before registration opened. And reservations for the third Techtour, held at IBM, reached capacity on the first day of registration.

Among the Conference's nine plant tours, attended by nearly 500 men and women, the visit to the Brooklyn Navy Yard took top honors in both interest and attendance.

On the opening day of the Conference, Wallace E. Brainard, speaker at the Annual Eli Whitney Lecture Luncheon, described the factory of 1970 as simply a warehouse type building containing a group of numerically controlled machines that automatically convert raw material to finished products. "This is not the dream-world automatic factory," he said, "but a realistic approach."

Mr. Brainard, a well-known authority on numerical control and chief engineer at the Servo Machine Tool Div. of Kearney & Trecker Corp., explained that the automatic factory, when realized, will be a return to the philosophy of Eli Whitney, who concentrated on putting the skill into the machine by building equipment that eliminated as much as possible the human element in operation.

In one of the most noteworthy sessions of the Conference, Russian and American industry were compared by four panelists who based their views on firsthand observation of Soviet manufacturing plants. The panel agreed that right now the United States is far ahead of Russia in the race for manufacturing supremacy. However, they cautioned, the Russians' determination to win will soon be realized if the U. S. continues its disinterest in the race.

"We can stay ahead if we'll stop our featherbedding in output restricting and if labor and management will sit down together and work out their problems," said H. Russell Beatty, president of Wentworth Institute, Boston, who visited Russia last summer with the Engineers Joint Council.

Others serving on the panel were: Carl F. Kayan, professor of mechanical engineering at Columbia University; Harold Mansfield, special assistant to the president of Boeing Airplane Co., and the discussion moderator, Col. Merle R. Thompson, secretary of the American Iron and Steel Institute's committee on foreign relations.

The four speakers frankly admitted that on their visits to Russia they saw only what their hosts wanted them to see. They saw enough, however, to state just as frankly: "The Soviet intends to be the the country that tools the world."

Long Range Planning Sparks Board Action

WHEN the reports of the eight Long Range Planning Subcommittees came up before the ASTME Board of Directors during the Annual Meeting in New York, the governing body of the Society faced the most significant—and time-consuming—item on its agenda. Evaluating each report in terms of service to the membership and adaptation of the Society to the changing and growing needs of its members, the directors modified points in some reports but, for the most part, gave official consent to the subcommittees' long list of recommendations.

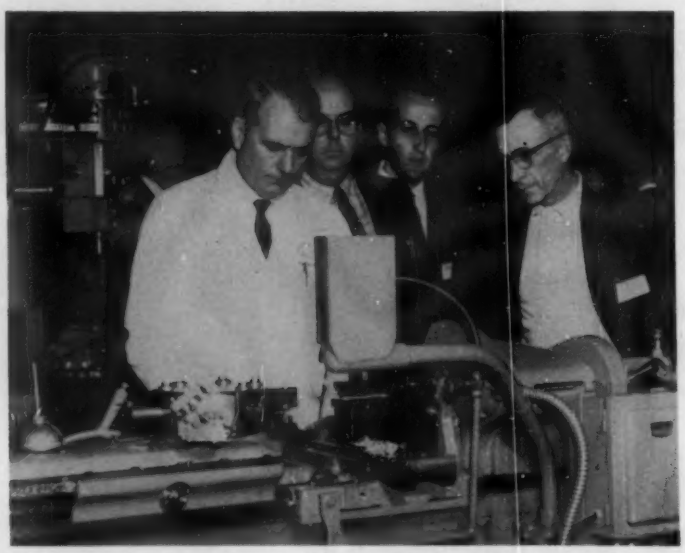
The most notable among the far-reaching effects of this board action are changes in the Society committee structure and a revision of the membership dues, both of which will be comprehensively treated in future issues of THE TOOL AND MANUFACTURING ENGINEER. Also, the Spring of 1963 was agreed upon as a target date for completion of the initial structure of a new Headquarters facility.

Other items on the board agenda brought approval of charters for Los Angeles Trade-Technical College Student Chapter 38 and for Senior Chapter 174—Sao Paulo, Brazil—contingent upon receipt of the necessary membership applications and funds.

By vote of the directors, an International Committee was established to study all ramifications of the setting up of off-shore chapters. Chairmanned by Philip Marsilius, the committee consists of Duane Brighton, John Groomes, Lloyd Hughlett and Wm. Moreland, ex-officio.

In considering the report of the National Finance Committee, the board approved a budget of $822,800 for the coming fiscal year.

New York's Coliseum gets a new address for May 22-26 as Vice President Verne Loeppert (right) and Dominic Scolaro, host committee chairman, rename Columbus Circle.



The epitome of concentration, these three Exposition registrants follow every move in the demonstration of a small turret lathe. Thousands of engineers and manufacturing executives attending the Tool Exposition took advantage of the opportunity to take a close look at all types of machines and tools in actual operation.

An old hand at exhibiting, William F. Jarvis displays a drilling and tapping machine with the finesse of long experience. The Jarvis Corp., of which he is president, has appeared in every Society exposition since the first tool show back in 1938. Besides being on the honor roll of exhibitors, Mr. Jarvis has been a member of the Society for 23 years and is a past chairman of Hartford Chapter 7.

NEW YORK

At the Annual Eli Whitney Luncheon, lecturer Wallace E. Brainard checks over an original Whitney musket, produced over 150 years ago in the first application of mass manufacturing techniques.

"Notable engineer, manufacturer and humanitarian," Robert G. LeTourneau (left) accepts one of the Society's highest honors, the ASTME Progress Award, from retiring President Dale Long.

Usually found on the speakers rostrum, President Wm. Moreland (right) and Vice President David Schrom (center right) take time out during the Conference for an informal talk with Headquarters staff members Charles Prince (center left) and Gilbert Seeley.

NEWSREEL

During a panel discussion on the race for manufacturing supremacy, two speakers reflect the gravity of the Soviet threat to America's industrial superiority.

Unaware of the photographer on the third-floor balcony, a crowd of Exposition visitors scrutinize second-floor exhibits with typical engineering precision. Many engineers spent days making their rounds of the 300-plus industrial displays.

Management Keynotes Chairmen's Meet

PRECEDING the Society's convention week in New York was an intensive session on management training and planning. The registrants for this day-and-a-half conference came not as engineers representing a multitude of industrial firms but as ASTME chapter leaders interested in one common goal—better, wiser and more effective chapter management throughout the coming year.

Armed with their most pressing management problems and an acute awareness of their leadership responsibilities, delegates from almost every Society chapter plus nearly 100 alternates convened at noon on Saturday, May 20, to open the 1961 Chapter Chairman's Conference. Also on hand were the national officers, directors and committeemen. But the national family were there only as consultants, as time-honored experts ready to give assistance, not as teachers. H. Dale Long, then ASTME president, made that quite clear. "Gentlemen," he declared, "during this conference your neighbor is your best teacher."

In continuing his introductory talk, President Long set the tone and purpose of the entire session:

Boning up for a barrage of questions from chapter chairmen is the College of Chapter Knowledge editorial faculty. TME Editor John Greve (left) reviews the editorial program with the other professors: (left to right) Joseph Petz and Ben Berlien, national directors who are also past chairmen of the National Editorial Committee; and John Hatter, chairman of the NEC this past year.

"We have met to refine our skills, sharpen our knowledge, and extend our talents . . . In everything we do, we'll strive for the ideas, the know-how and the attitudes that will produce for us back in the chapter."

Tools of the Chairman's Trade

First off, the chairmen were briefed on one of their most important tools—the national committees. In concise presentations the head of each national committee showed how his organization could best serve the local chapters. The delegates then separated into three workshop groups and got down to the real meat of the conference. Each group was presented with an actual chapter management problem and in teams of six sought a solution. Here, the chairmen got a full-fledged dose of practical application, bringing their own experience and knowledge to bear and benefiting from the experience and knowledge of all their colleagues.

Sunday brought a review of Saturday's solutions, more workshops—but this time with the chairmen posing their own specific chapter problems for remedy—and the College of Chapter Knowledge. The college was the ballroom of the Statler Hotel, where each national committee had set up a decorative booth to display its services to the chapter. Clothed in cap and gown, a committeeman, director and staff member were present at each booth to answer the chairmen's questions and talk over their problems. And incidentally, the delegates kept the professors on their toes.

Outcome Looks Good

The success of the conference was apparent in the enthusiasm of the chapter chairmen, the many ideas generated by them and the concluding remarks of new ASTME President William Moreland: "If we could but multiply the sincere effort expended here throughout the coming years, the Society's cup in 1975 would be brimful and running over." The proof of the pudding, however, will be in the management of each of the Society's 173 chapters in the weeks and months ahead.

Edward Gillaspy (left) accepts the National Editorial Award from George Minarik, past chairman of Chapter 11.

Editorially Speaking,

Five Rate High

FIVE chapter editorial chairmen have received the National Editorial Award for their energetic and enthusiastic reporting. Members of the 1960-61 National Editorial Committee—John C. Hatter, chairman; William Moore, Charlton Brown, Rayburn M. Knabe and James Rodgers—announced the winners after considering all reports published in THE TOOL AND MANUFACTURING ENGINEER this past year.

The work of each editorial chairman was judged on the basis of quality, attractiveness (eye appeal) quantity and information. Those obtaining the highest scores were Paul J. Bodnar, Long Beach; James J. Denney, Indianapolis; Robert D. Ellingson, Knoxville-Oak Ridge; Edward V. Gillaspy, Twin Cities; and Clarence J. Keller, Cincinnati. These men, who have maintained an outstanding record through their consistently newsworthy reporting, were presented certificates at their local chapter meetings. They well deserve the honor awarded them.

When the National Award was bestowed upon Bodnar, Long Beach chapter also expressed its best wishes for the recipient's success in his new venture with the Armed Forces Atomic Recovery Program. . . . Denney, whose personality is summed up by Indianapolis chapter members as "a grand person who isn't grandiose," writes a monthly feature in Chapter 37's bulletin. . . . A relatively new member, Ellingson joined Knoxville-Oak Ridge chapter in May 1959 and is an engineer at Union Carbide Nuclear. . . . Gillaspy, now a member of Minneapolis chapter, also contributes to his monthly bulletin by doing personality and meeting write-ups. He is a production engineer at Minneapolis-Honeywell. . . . Keller, a tool engineer with Cleveland Automatic Machine Co., is a "third termer" who began his editorial duties in 1959.

Paul J. Bodnar (left), one of the recipients of the National Award, is congratulated by Owen D. McDougall, chairman of Long Beach chapter.

H. E. Alvey (left) past chairman of Knoxville-Oak Ridge chapter, presents the National Editorial Award to R. D. Ellingson, 1960-61 editorial chairman.

Walter Graber (left), chairman of St. Paul chapter, receives the charter from H. Dale Long, ASTME president and chartering officer.

Long Honored, St. Paul Chartered

ST. PAUL, Minn.—"The God of Peace," a massive onyx statue, looming 36 feet tall, stands in the Memorial Hall of St. Paul's City Hall. On April 20 a miniature replica of that 60-ton figure, known also as the St. Paul Indian, was presented to H. Dale Long, ASTME president. This is an honor only rarely awarded to outstanding citizens and visitors and was part of St. Paul chapter's chartering ceremonies. It was conferred upon Long by the city's Mayor, the Honorable George Vavoulis.

The presentation climaxed an evening of chartering ceremonies at which Long officiated. He installed Walter Graber, chairman; Edward J. Ryan, first vice chairman; William J. Huot, second vice chairman; Russell Moga, third vice chairman; William Tkacz, secretary; and Richard Swifka, treasurer; and, as featured speaker of the evening, he gave a talk on "Opportunities Unlimited."

Minneapolis, St. Paul's sister chapter and sponsor, was well represented at the ceremonies and gave the new group of 96 members $220 for initial operating expenses and an additional $100 for the establishment of a scholarship fund. Many members of St. Paul Chapter 172 were previously affiliated with the Minneapolis group—proof of the harmony which exists between the Twin Cities.

Other guests included Bob Johnson, chairman of the National Membership Committee; George Torrence, membership area captain; and John Groomes of National Headquarters.—*T. Prifrel.*

Research—A Management of Paradoxes

DALLAS, Tex.—Addressing North Texas chapter, R. W. Olson, vice president of research and engineering at Texas Instruments, recently paid tribute to the work of technical societies such as ASTME. "You and your colleagues throughout the world are, I believe, the principal instrument in the final step of bringing the results of research, development and engineering to society as a whole," he said.

Olson continued his speech, "Research Management—the Management of Paradoxes," by pointing out certain incongruous facets of the field: the main paradox facing management is that research, to be most effective, must seek an optimum level of control—enough to insure usefulness, yet sufficient freedom to permit creativity.

Olson's answer to the conflict was one of planning. "It is my hope," he said, "that research may soon be utilized more effectively through appropriately firm, but not stifling, management. We will, however, be walking the razor's edge."

—*W. R. Ellis*

Toronto Bulletin Has New Look

TORONTO, Ont.—In their search for a new monthly bulletin cover, Toronto chapter recently sponsored a design contest for chapter members and students of Ryerson Institute of Technology. Student J. M. Deck (right) was awarded first prize and is shown receiving congratulations from Eric Crawford, past Toronto chairman. —*H. T. Thompson*

Students Chartered at Oregon Tech

KLAMATH FALLS, Ore.—With an impressive roster of 77 charter members, Oregon Technical Institute student chapter was recently chartered in Klamath Falls, Ore. The ceremonies began with introductions by toastmaster Bill Furrow, charter member of ASTME, and a welcome to all by Dr. Winston Purvine, director of O.T.I.

The chapter's new officers were then installed by Ben Berlien, national director. They are: Ted Morris, chairman; John Alexander, first vice chairman; Rodney Nissen, second vice chairman; Sharon Wilson, secretary; and Bill Jensen, treasurer. Morris received the chairman's pin from Bill Gardner, chairman of Portland chapter, and the chapter charter from Milt Sheely, member of the National Education Committee and professor of engineering at Oregon State University.

The evening's program continued as membership pins, donated by the Portland chapter, were presented to the new student members. Berlien, guest speaker of the evening, closed the ceremonies with an address on both the functions and objectives of ASTME.

Oregon Tech administers two and three-year technical programs in the training of persons whose interests are directed chiefly toward the application and operation of engineering or scientific processes. Upon graduation students are qualified to work as junior engineers in production planning, method analysis and production control. —*T. L. Nelson*

Ted Morris (left), chairman of OTI student chapter, receives the charter from Milt Sheely, member of the National Education Committee and Portland Chapter.

Reports in Brief . . .

Canada

S. R. Palmer, secretary of HAMILTON chapter and engineer manager at the Tool and Gage Div. of John Bertram and Sons, spoke recently at a meeting of his own chapter. During his talk, "Tool and Manufacturing Engineering, a Challenge," Palmer outlined the qualifications which a leader in this field requires and emphasized the dire necessity for more extensive research if Canada is to maintain its competitive powers.

Northeast

During a recent technical meeting of PITTSBURGH chapter 8, N. L. Caban of Westinghouse Electric Corp. pointed out some of the more advantageous aspects of numerical control systems. They don't have to "think" about the next operation, don't get tired, never have hang-overs or nagging mates and don't require coffee breaks! . . . HARTFORD chapter celebrated the start of its silver anniversary year with its annual Ladies Night dinner dance and installation of officers.

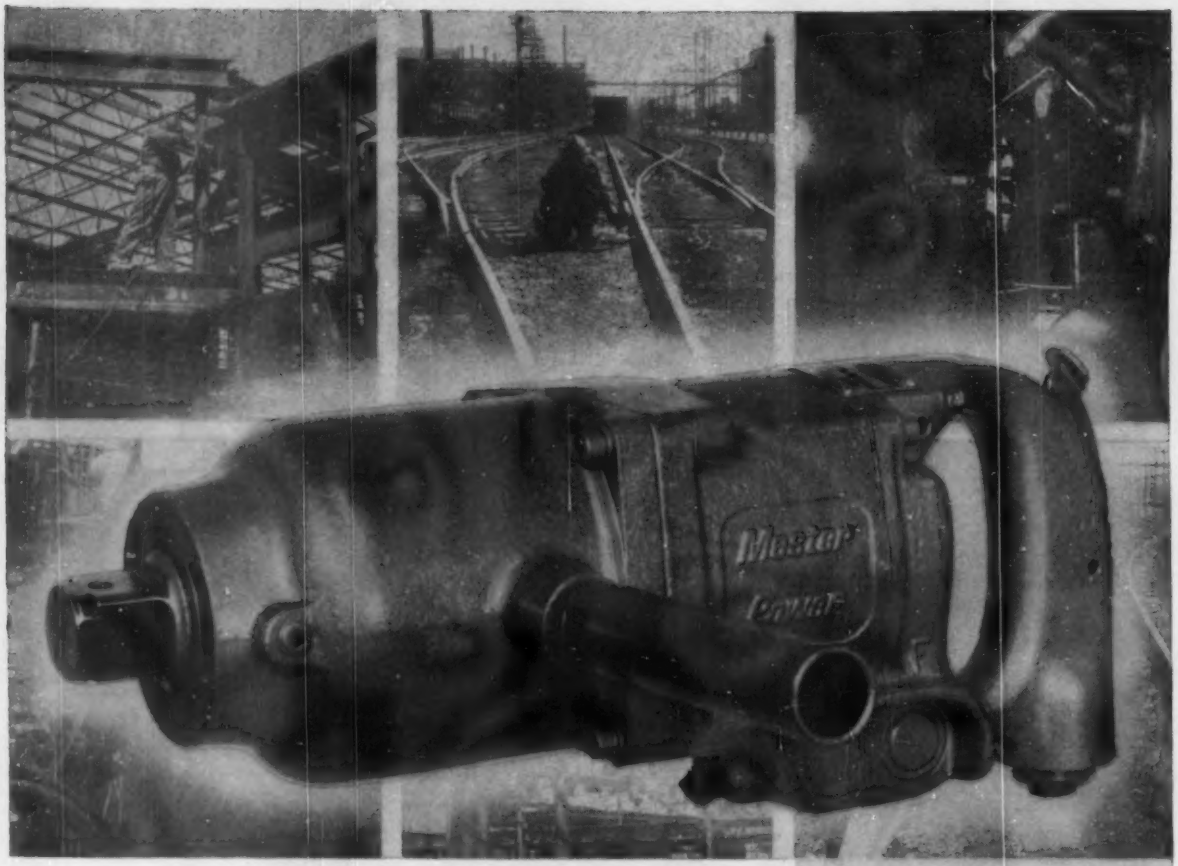
positions wanted

PRODUCTION GEAR SUPERVISOR AND TECHNICIAN—30 years' experience in manufacturing and inspection of gears, all types—fine pitch, engine, traction and aircraft. Production supervisor from foreman to superintendent. Have written five articles for periodicals. Served on several AGMA technical committees. Relocating no problem. Resume upon request. Write to Classified Ads, Dept. 209, 10700 Puritan Ave., Detroit 38, Mich.

GRADUATE ENGINEER—experienced in numerical control, desires career position. Write to Classified Ads, Dept. 210, 10700 Puritan Ave., Detroit 38, Mich.

position available

MANUFACTURER'S AGENTS WANTED—Reputable diamond wheel manufacturer has several choice territories available on exclusive basis for representatives willing to give action and progressive representation for rapidly expanding company. Write: Diacraft, Inc., 26538 West Seven Mile Rd., Detroit 40, Mich.



FEATURES OF THE ALL-NEW MASTER POWER 990 IMPACT WRENCH

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NEW LIGHTWEIGHT CHAMP FOR HEAVY-DUTY WORK

This new Master Power 990 Impact Wrench went to work more than a year ago in shipyards, steel mills, rail yards, on off-the-road equipment, on steel erection and truck assembly. The toughest kind of work in the roughest environments. Our documented performance data is your proof that the new 990 delivers ultimate power, positive engagement, maximum life.

A combination of "roll action" and precision-engineered, cam-timed impact mechanism gives you a tool with no springs, no snap rings, no lost motion. The tried and proved ball-and-race principle of smooth, almost frictionless rolling action engages and disengages impacting blows with precise timing. The powerful air motor and clutch hammer are independently suspended on heavy-duty bearings. You get positive, full engagement regardless of power input. Result: A compact, light weight (21 lbs.) tool doing up to 1¼" high tensile bolting with less vibration, less torque to operator. Its simplified design permits assembly and disassembly with ordinary tools. Try this new tool *now!*

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Progress in Production

TWO COMPANIES AUTOMATE THEIR FORGING OPERATIONS

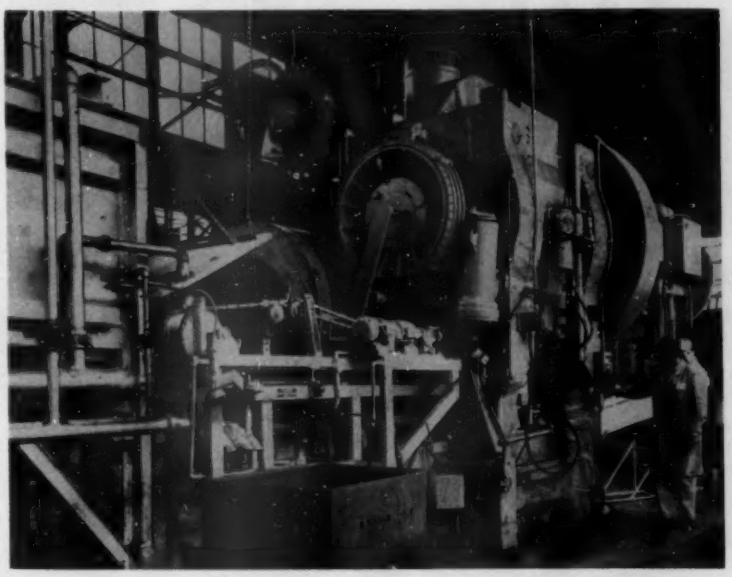
Two major manufacturers of forgings—Eaton Mfg. Co. and American Forge Div., American Brake Shoe Co. —are now producing finished parts on automated lines. Although the setups of both companies are dissimilar, each embodies the same principles: the automatic movement of billets from a furnace through a forging press.

Principal units in Eaton's forging line are a Selas Furnace, a 6000-ton Ajax forging press and a small conventional trim press. The furnace, a rotary-hearth type built to index in conjunction with the press, handles 150 billets per hour. These are heated to 2400 F and withdrawn from the furnace by an automatic unloading device. The billets then travel to the press loader by automatic conveyor.

Three dies mounted on the bed of the forging press convert the billet into ring-gear forgings, complete except for flash which is subsequently removed in the trim press. In-press handling of the billet through buster, blocker and finishing dies is effected with an automatic transfer unit. When in-press operations are complete, the transfer unit places the forging on a conveyor that carries it to the trim press.

The AmForge automated line is set up to manufacture track links for crawler tractors. Because these parts are small in comparison to the ring gears previously discussed, the entire line is much more compact than the Eaton line. In operation, a gas-fired oven heats billets of 1040 steel to 2200 F and discharges them to a transfer press where they are converted to finished links.

Benefits resulting from the use of automation in forging operations are many. The principal benefit, aside from increased production, is improved metallurgical properties in the finished work. Drop hammers—formerly used in both the Eaton and AmForge operations—have a deleterious effect on steel because they pound oxidized scale into it during repetitive coining. In both these lines, only one die closure per operation is required.

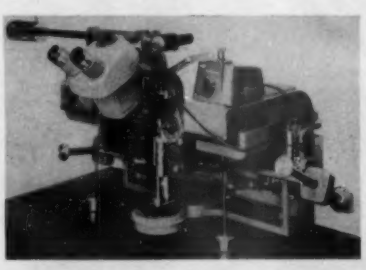


Billets heated to 2400 F in a rotary hearth furnace are automatically withdrawn, then travel to the forging press loader on automatic transfer equipment. This American Forge complex is 40 ft long and 15 ft wide.

SEMIAUTOMATIC MACHINE MAKES MICROSCOPIC WELDS

Wire one-sixth the diameter of a human hair is fed and bonded to stripe by a new machine for use by the semiconductor industry.

A binocular microscope enables the operator to see the target—a stripe that measures 0.001 inch in width and 0.003 inch in length—to which fine gold wire is bonded. A system of controls deamplifies and transfers the operator's finger movements into minute manipulations in both the horizontal and vertical planes to position the wire and the bonding tool. Positioning accuracy is from 0.000010 to 0.0000015 inch.



With the part clamped in place, the wire and bonding tool are horizontally and vertically positioned by minute manipulations translated from operator adjustments of the two chessman joystick assemblies and Z-levers.

The machine can handle wires with diameters from 0.0002 to 0.005 inch and its heat column is interchangeable to suit various headers.

Adjustable, thermostatic control of heat insures uniform bonding temperatures. Since the operator can extend or retract the quantity of wire fed from the continuous length reel, the use of fixed lengths is eliminated. Spoilage is minimized by a dual force bonding tool which provides one force gentle enough to effect a bond of the wire to the stripe without damage and a second force firm enough to bond at the transistor post and sever the wire without undesirable results. By a flow of inert gas in the

MARK FREIGHT CAR WHEELS OR PEN POINTS

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Whether you need an automated 250 ton unit for marking hot, pressure cast railroad car wheels or a machine for marking parts as delicate as a fine pen point, SCHMIDT has the experience and facilities to provide the right equipment for the job.

The in-line production marking machine above accepts hot (1200° F.) car wheels, positions and marks with consecutive serial number and other data in deep permanent characters—and discharges wheel to conveyor for next operation.

COMPLETE LINE OF MARKING EQUIPMENT

Single machines or entire automatic marking stations including machines, feeds and lettering tools—are engineered, designed and produced to meet your requirements.

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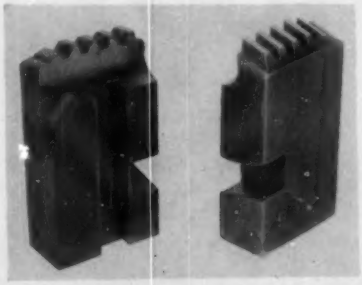
heat column, the bonding area is shielded at all times from oxidation or contamination.

Originally intended for use in the manufacture of mesa type transistors, this equipment built by Kulicke and Soffa Mfg. Co., Inc., Philadelphia, can be used also in the production of diodes, solar cells, micromodules, molecular electronic devices and integrated circuits.

LOW TEMPERATURE NITRIDING UPS WEAR RESISTANCE

Tufftriding—a molten salt-bath process for mild, stainless and alloy steels and cast irons—results in tough, wear-resistant surfaces with increased fatigue strength. Originally developed in West Germany by Degussa-Durferrit and adapted for use in the U.S. and Canada by Kolene Corp. of Detroit, Mich., the process has already been used on hydraulic components, airplane landing-gear parts, punches and dies, automotive crankshafts, forging dies and high-compression cylinder heads. It is also being used to improve the tools used to process parts.

The molten-salt bath used is composed of potassium cyanide and potassium cyanate. Decomposition of the salt in contact with ferrous metals



Tufftriding this M-2 high-speed steel thread-cutting die brought its performance almost up to that for tungsten carbide.

liberates carbon and nitrogen. The carbon quickly forms iron carbide particles at the surface of the part which, in turn, act as nuclei and the nitrogen precipitates at the surface to form a tough, ductile compound layer of iron nitrides. As the treatment progresses, excess nitrogen diffuses deeper into the metal, attaining a depth of 0.015 to 0.018 inch. This free nitrogen stops incipient cracks before they can progress to the surface and become fatigue cracks and helps to increase the bend strength of the material.

Tufftriding is carried out at temperatures of 1000 to 1050 F with soak-

ing times averaging from 90 to 120 min. Low temperatures and short cycles not only make the process economical compared to other heat-treating and nitriding processes but also play an important role in maintaining product quality.

ARGON BLANKET BOOSTS QUALITY OF DEGASSED AIRCRAFT STEELS

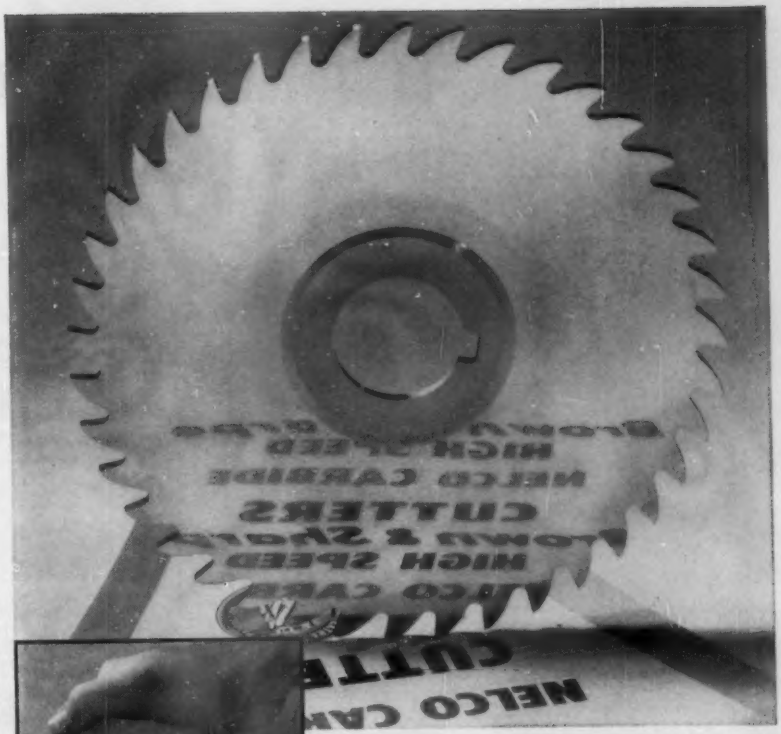
Two refinements to the process of vacuum degassing and pouring molten steel measurably improve aircraft quality alloy steels. One is a method of pouring the degassed steel through a blanket of argon gas and into ingot molds filled with argon. The other refinement involves putting additives in the molten steel while the ladle of steel is under a high vacuum inside the degassing chamber.

The first method—aimed at keeping oxygen in outside air from reaching the molten steel after it has been degassed—is done by attaching a 15-inch-diam steel collar around the pouring outlet in the bottom of the ladle. Attached to this collar is a feeding hose from the tanks of compressed argon. The ladle is then lowered to within an inch from the top of the ingot mold, which has previously been filled and sealed with argon gas. The argon gas is turned on, filling the collar with the inert gas; the stopper rod is opened; and the steel is poured through this blanket of gas.

The second method involves installing an air tight hopper in the top of the large vacuum degassing chamber. Limestone, aluminum and other additives are placed in the hopper before the vacuum degassing process starts, sealed tight, and released during the process. The addition of these materials at this particular time improves the quality of the steel and provides an insulating cover over the molten steel during the pouring period.

Complex laboratory testing procedures, which measure gases and other impurities in steel in fractions of parts per million, show that these two refinements do improve the quality of aircraft quality alloy steels. They also add some costs to producing this quality of steel.

The process—developed by A. Finkl & Sons Co., Chicago—is one of the most effective and economical. A further advantage is that the ladle can be easily moved from one ingot to another, making several ingots from one ladle of steel. One automotive forging shop is producing 24.7 percent more hot work forgings per sinking in each set of FX nickel-chromium-molydenum vacuum degassed steel die blanks than from nondegassed steel die blocks.



A super-finish saw so tough it can't scratch itself.

NEW
Brown & Sharpe
Sawperior

GREATEST ADVANCE IN SLITTING SAWS IN 50 YEARS!

The mirror-like finish of new B&S "Sawperior" slitting saws mark 3 new developments that more than double production and make other saws virtually obsolete!

NEW Alloy High Speed Steel for Longer Life.

NEW Tooth Design for Fast Free Cutting!

NEW Super-Finish prevents Chips Seizing and Galling!

PRODUCTION BENEFITS

Shop tests prove the new tooth geometry and mirror-like finish give up to 4 times as much slitting production between sharpenings.

Super finish on sides permits use of less concavity or side clearance thereby providing a stronger saw section and a stiffer, more accurate saw.

Smooth side finish resists scratching, resists corrosive action of coolants and rust.

New saw design requires less milling machine power thereby allowing heavier cuts without strain or chatter.

New saw geometry and super finish sides give smoother surface finish in cut.

Send for B&S Cutting Tool Condensalog . . .

For that EXTRA Edge in Production!

Brown & Sharpe

Cutting Tool Division
Brown & Sharpe Mfg. Co.
Providence 1, Rhode Island

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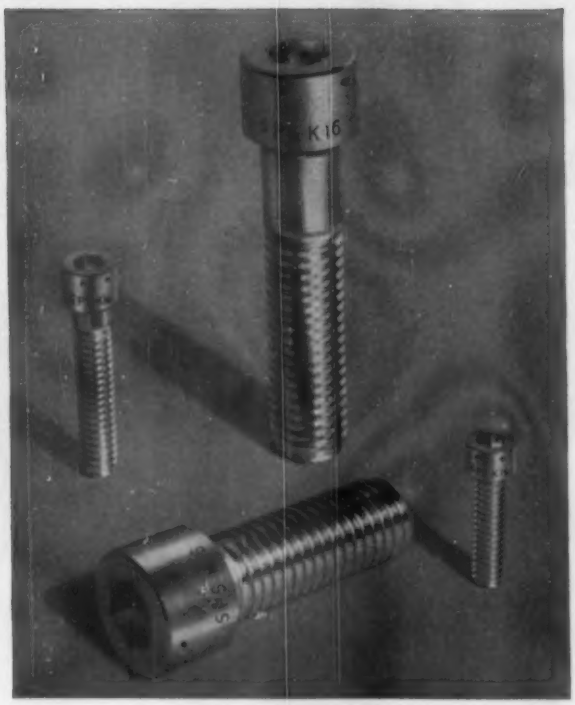
Fatigue Life of Threaded Joints Automatically Quadrupled with New UNBRAKO K16 Cap Screws



New K16 tension fasteners were developed by SPS to replace costly specials in a growing number of critical industrial applications demanding increased fatigue resistance. Cross drilling is standard.

90% of today's threaded fastener failures are due to fatigue. How about your assemblies? Are your fasteners giving you an adequate safety margin on fatigue? Or would you like a little more assembly insurance—without using more or larger fasteners or paying the price of specials.

You can now get this extra fatigue protection in a *standard* fastener—new UNBRAKO K16 socket head cap screws. They give you *a bonus of 300% more fatigue life.*

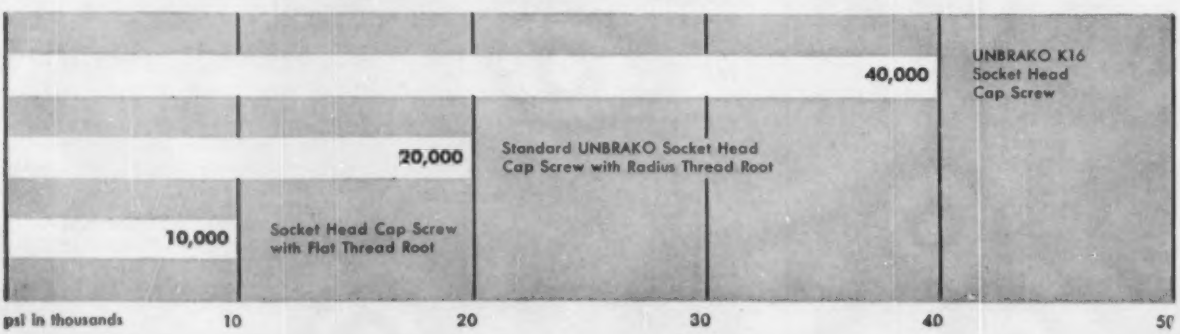
How does SPS achieve this special fatigue performance in a standard fastener? By taking these extra steps—

- Threads rolled *after* heat treat for extra fatigue strength.
- Head-to-shank fillet area cold worked after heat treat to increase fatigue resistance.
- Shank precision ground after heat treat to insure no decarburization, and for closer body tolerances.
- Magnetic particle inspection per SPS Specifications and MIL-I-6868 to insure reliable fasteners.
- These features are in addition to the proven UNBRAKO pHd* head, which delivers far greater holding power, and the SPS Hi-Life thread root form, which reduces stress concentrations . . . both standard with all UNBRAKO socket head cap screws.

*proper Head design

Only the new UNBRAKO K16 socket head cap screw gives you the benefits of these extra operations in a standard fastener . . . gives you the extra fatigue strength that is almost mandatory in some of today's critical industrial applications.

COMPARISON OF ENDURANCE LIMITS—5/16-24 Socket Head Cap Screws



UNBRAKO K Series fasteners are available currently as socket head cap screws in standard sizes #8 through ½ in. diameter in 8740 A.Q. steel. Other configurations and series to come. See your authorized industrial distributor for more information. Or write Standard Pressed Steel Co. for new Bulletin 2707. INDUSTRIAL FASTENER DIVISION, SPS, JENKINTOWN 37, PENNSYLVANIA.

SPS

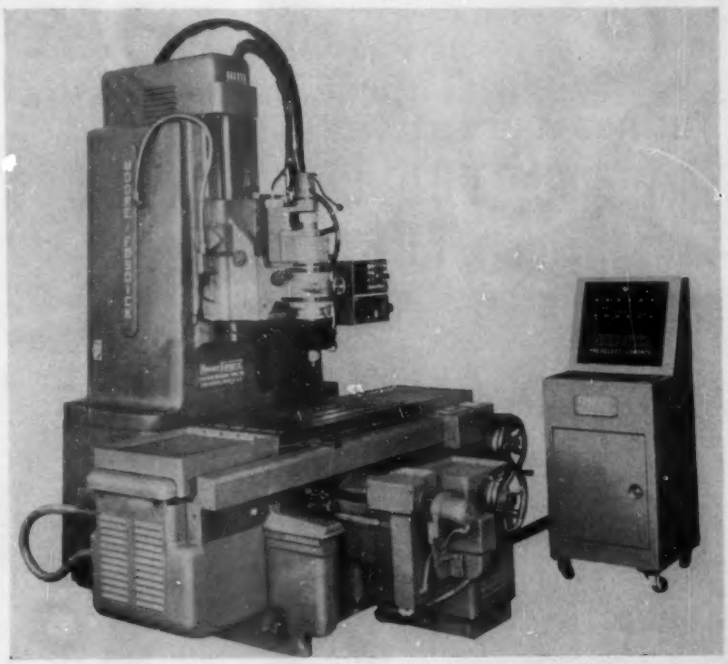
where reliability replaces probability

TOOLS of today

Numerical Control Has Manual Input

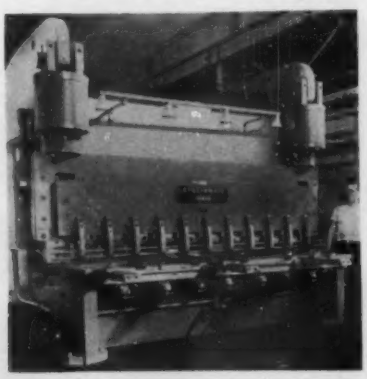
Shown here is the Fosmatic preselect control for manufacturers doing jig boring or jig grinding who desire the speed and accuracy of numerical control but cannot justify a full tape control setup. The unit is housed in a separate console, displaying on its face a series of numerical dials. While a machining operation is being performed, the operator sets the coordinates of the next operation on these dials. The machine will move to the new location at the touch of a button as soon as the previous operation is finished. This is basic numerical control, with the substitution of manual input for tape input.

Fosdick Machine Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio. **Circle 401**



Hydraulic Shear Cuts Extra-Heavy Plate

By adjusting the rake upward, the Series 8N10 hydraulic shear can shear materials that exceed its 1-inch x 10-ft mild steel plate nominal capacity. When shearing materials lighter than the nominal capacity the rake of the upper knife, which is adjustable from zero to ⅞ inch per ft, can be adjusted downward to an angle low enough to minimize distortion in the back piece. The machine's hydraulic drive—incorporating a manifold block to bring the valves together in one compact assembly—is powered by a 40-hp motor.



Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio. **Circle 402**

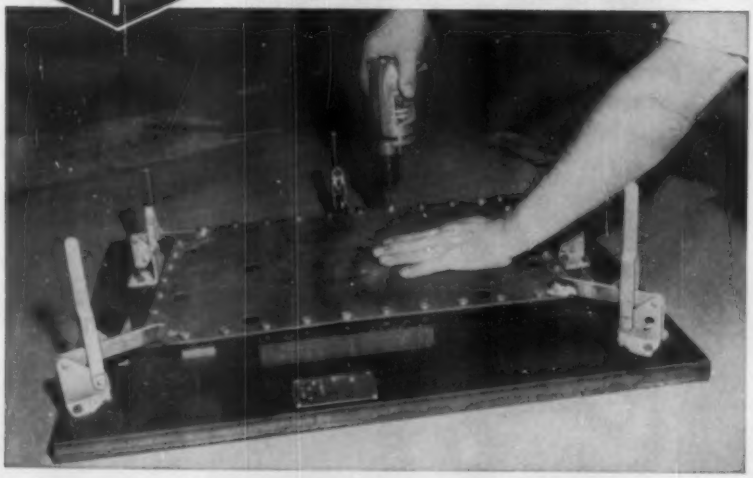
Internal Grinder Handles Straight, Tapered Bores

Parts such as diesel nozzles can be ground on this double-end internal grinder—a machine designed with two opposed wheel slides and a rotary indexing worktable carrying two workheads for grinding two parts at a single chucking of a workpiece. The work-

IT'S A FACT

FOR POSITIVE HOLDING OF COMPONENTS IN JIGS AND FIXTURES...

YOU CAN DEPEND ON DE-STA-CO TOGGLE CLAMPS



Simple drilling fixture made up of 5 toggle action clamps mounted on a plywood base holds drill bushing plate firmly in position.

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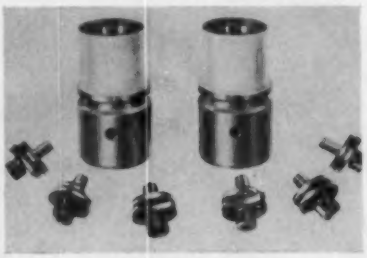
table, supporting the workheads, is centered between straight bore and taper bore grinding units. Units may be operated simultaneously or individually. Other features of the grinder include automatic wheel dress cycling; compound axial and angular slide permitting reciprocal grinding of the tapered bore; and diamond sizing for both straight and taper bore grinding.

Bryant Chucking Grinder Co., Springfield, Vt. **Circle 403**

Insulated Die Set Bushings Allow Spark Machining

By using these insulated demountable bushings in a die set and mounting an expendable punch or copper electrode directly on the production punch, the die can be machined to required accuracy by electrical discharge. The process substantially reduces the mounting



and aligning time required when the die is machined before being mounted. They have an insulated surface which contacts the punch holder and are furnished with insulated mounting clamps. They withstand an electrical potential exceeding 1100 volts. Die sets equipped with the bushings can be put into production use after machining the die by replacing the insulated clamps with standard steel clamps. They are stocked in 1, 1¼ and 1½-inch sizes.

Danly Machine Specialties, Inc., 2100 S. Laramie Ave., Chicago 50, Ill. **Circle 404**

Casting Machine Mixes, Dispenses Plastics

This machine is used to mold plastics based on reactive resins such as epoxies, polyesters and polyurethane foams which set by the admixture of two or more components. The Mark II/25 is a plunger-piston-pump unit. The two plunger pumps are driven simultane-

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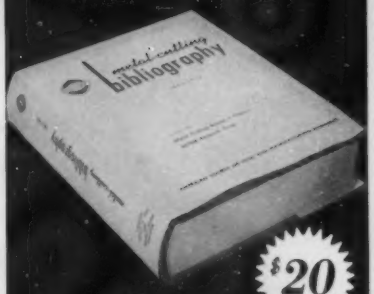
this

BOOK



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This authoritative, informative bibliography is the latest, most up-to-date reference work on chip making processes available. Covers metal cutting literature from 1943 to 1956. More than 18,000 books, articles, papers in English and foreign languages reviewed by The John Crerar Library in Chicago, who compiled the book. Informative abstracts of 5,593 original works were prepared especially for this bibliography.

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Detroit 38, Michigan

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ously by an air motor. The unit can dispense up to 25 cc of resin per shot at any required ratio from 1:1 to 1:25 with an error in ratio less than 0.1 percent and at pressures up to 5000 psi. Jobs such as production potting or encapsulation of electronic components, molding gears from rigid urethane or polyester materials and dispensing reactive adhesive materials for production cementing operations are well-suited to its use. The liquid viscosity range that can be handled is from 10 to 50,000 centipoise.

Leal Corp., P.O. Box 53, Oaklyn 6, N. J. **Circle 405**

Tracing Attachment Gives Added Versatility

This tracing attachment—because it mounts to the ram or turret or takes the place of the side head—converts vertical turning and boring machines into contour turning lathes. The Mark

X VTL attachment is hydraulically operated using the servo valve and cylinder principle. Specifications include a cylinder bore of 4 inches; stroke, 9 inches; and tracer stylus pressure, 9 to 12 oz. Toolholders are available for ¾, 1 and 1¼-inch-square tools.

True-Trace Corp., 9830 Rush St., El Monte, Calif. **Circle 406**

Portable Shear Scissors Hard-to-Reach Areas

This air-powered, portable sheet metal shear combines a versatile cutting head with air motor operation. The shear scissors a 7/32-inch path through such materials as 18-gage mild steel, 1/16-inch laminated plastic, aluminum, tin and fiberglass. Cuts can be started from either the edge of the sheet or a ¼-inch access hole, then continued for any desired pattern of lines or circles having radii up to 2 inches. The aluminum housing rotates through 360 deg. The shear is available in two models—

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PRODUCTION HEAT TREATING EQUIPMENT

of any of these types

* **BATCH**
* **CONVEYOR**
* **ROTARY**
* **CAR TYPE**
* **SHAKER HEARTH**
* **ROLLER TYPE**
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The large magnesium vacuum-plate is precision machined with 80 milled grooves and 80 drilled holes.

MACHINABILITY OF MAGNESIUM TOOLING PLATE

cuts production cost of giant film holders

46-inch-square vacuum film holders of magnesium tooling plate hold film and half-tone screens accurately in place in process cameras made by Robertson Photo-mechanix, Inc., Chicago.

WHY MAGNESIUM TOOLING PLATE? Unsurpassed machinability cuts the time and cost of precision-machining the 80 grooves and 80 holes in the plate . . . as-delivered flatness eliminates the need for surface machining . . . and light weight assures easy handling and accurate positioning of the holder in use.

Lightweight magnesium tooling plate offers these and many other advantages for tooling. It's the lightest of all structural metals, yet it's stiff and rigid. And being the easiest-to-machine metal, it reduces machining time and tool wear. New close thickness tolerances, flatness and high dimensional stability provide lasting accuracy, with minimum warping after machining.

Find out how lightweight, machinable magnesium tooling plate can cut your tooling fabrication and handling costs. Write THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Dept. 1111FJ-7.

DOW **THE DOW METAL PRODUCTS COMPANY**

Division of The Dow Chemical Company

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GET FAST DELIVERY OF MAGNESIUM TOOLING PLATE FROM THESE DISTRIBUTORS

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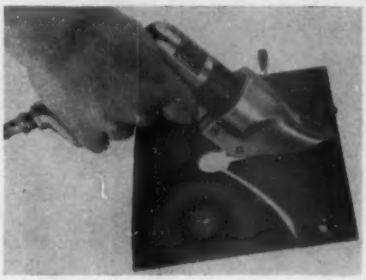
THE DOW METAL PRODUCTS COMPANY

DOW

TOOLS of today



the pistol-grip, which has a 15/16-inch offset, trigger throttle and a built-in oiler, and the straight type, which has a lever throttle and a 15/16-inch offset. The latter model requires an external oiler.

Buckeye Tools Corp., 5003 Springboro Pike, Dayton 1, Ohio. **Circle 407**

Carbide Toolholder Locks Insert with Cam Action

Basic principle of the Carb-O-Lock toolholder is a cam action lock which engages the insert by an eccentric on the central cam pin. This provides a positive lock that cannot be loosened

by vibration or pressure of the cut and eliminates protruding screws or clamps. The carbide toolholder is available in 15 styles and 124 sizes for triangular and square inserts. Shank sizes range from ½ to 2 inches square.

Metallurgical Products Dept., General Electric Co., Detroit 32, Mich. **Circle 408**

Vibration Tester Exposes Hidden Defects

This fatigue testing unit—using horizontal vibration—is designed for pilot spot or production line testing of electronic, electrical, optical and mechanical machines weighing up to 150 lb. Model 150-HLA-T has an overload safety factor of 50 percent and operates on selected cycles or through the full frequency band of 5 to 100 cps. Acceleration and deceleration are electronically controlled.

All American Tool and Mfg. Co., 8041-C Lawndale Ave., Skokie, Ill. **Circle 409**

Electrostatic Chuck Holds Thin Materials

Designed for use on rotary type surface grinders is this electrostatic chuck which is available in 6 and 12-inch sizes. The system is capable of holding flat, ring-shaped parts of any nonmagnetic material, including brass, copper, aluminum, stainless steel, beryllium and

the other exotics. It will hold plastics and ceramics when flashed with a conductive coating. The system consists of the chuck itself, a compact electrical control apparatus and a mist coolant unit. It operates on 110-volt, 60-cycle, single-phase power with a maximum consumption of 75 w.

Electroforce, Inc., Fairfield, Conn. **Circle 410**

Punch Press Has Interchangeable Power Unit

Features of the Kenco Kompac punch press are a totally enclosed but easily accessible flywheel, crankshaft, connection rod and ram; a rear-mounted flywheel; and a self-contained interchangeable power transmission unit which is available in various stroke lengths from ¼ to 2 inches. Power units contain a one-piece crankshaft mounted on heavy roller bearings in a lubrication reservoir; a roller clutch; a solenoid-operated trip action for posi-

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tive single tripping; and a positive action brake for stopping. A ½-hp, 1750-rpm motor and an electrical foot or hand control switch are included with the press. The punch press is available in 3 and 5-ton capacities.

Kenco Mfg. Co., 5211 Telegraph Rd., Los Angeles 22, Calif. **Circle 411**

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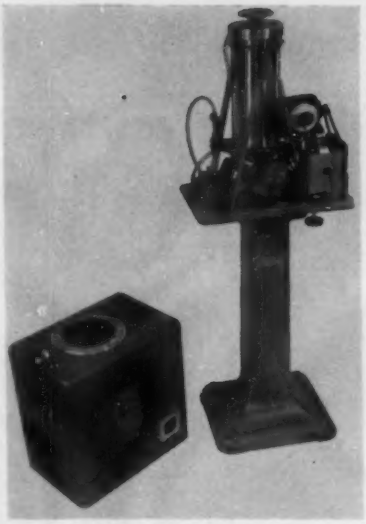
Feeding Unit Gives Uniform Feed Rates

Uniform, pulsation-free feed for metering precise quantities of very fine powders is provided by this feeder. Called the Sylco CCC power-feeder, it can be used for plasma and flame coating and powdered-carbide deposition. It consists of a pressurized canister equipped with a feedscrew which carries the powder into a carburetor. A carrier gas picks up the powder and conveys it to the point of application.

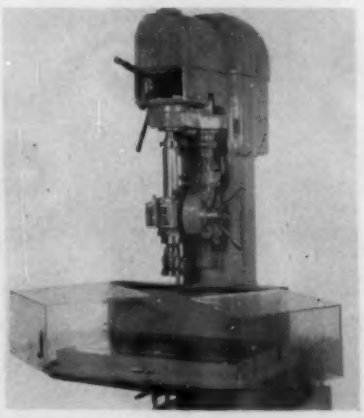


Where feed rate varies with the powder level, the positive feed assures a uniform, unvarying feed rate whether the canister is full or nearly empty. The feeder will handle powders from coarse 80 mesh down through micron sizes. Feed rate can be varied between 0.4 and 3.5 lb an hr for a typical aluminum oxide powder of –325 mesh. The 150-lb unit operates on single-phase, 60-cycle, 115-volt current.

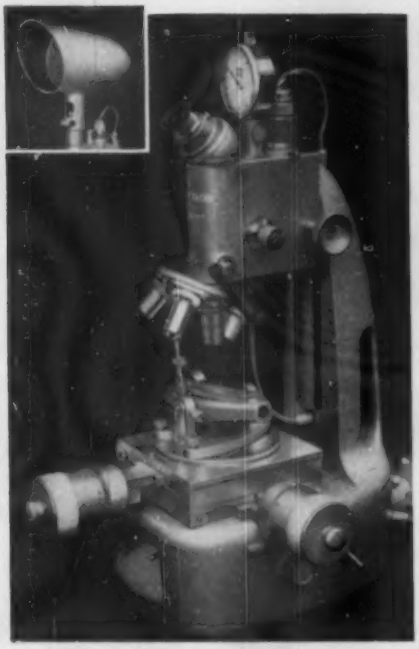
Sylvester & Co., 17706 Miles Ave., Cleveland 28, Ohio. **Circle 412**

Hollow Spindle Machine Drills Exotic Metals

Superhard materials are drilled fast and clean with this hollow spindle drilling machine. Using a cold-point drill or hollow diamond core bit, the machine can drill holes in exotic metals such as titanium, stellite, René 41 and stainless steel as well as ceramics, fused cast refractory blocks, glass, marble, granite and reinforced concrete. The RPMster is available in three models with capacities of 1, 1½ and 2 inches. Feeds are 0.003 to 0.006, 0.006 to 0.009 and 0.006 to 0.010 ipr



MEASURE TO 0.0001" IN 3 DIMENSIONS WITH UNITRON'S TOOLMAKERS MEASURING AND METALLURGICAL MICROSCOPE



The UNITRON Model TM is more than just a measuring microscope. It is the only instrument which combines in one stand a completely equipped toolmakers microscope for precise measurements — LENGTH, WIDTH and DEPTH, and a metallurgical microscope for examining the structure of polished metal samples under high magnification.

NOTE THESE QUALITY OPTICAL & MECHANICAL FEATURES

- **Objectives:** achromatic, coated, 3X, M10X, M40X. **Eyepiece:** coated Ke10X with crosshair.
- **Magnifications:** 30X, 100X, 400X; up to 2000X with accessories.
- **Focusing:** Both dual control rack and pinion coarse and micrometer-screw type fine adjustments. Body has locking device.
- **Three Illuminators:** sub-stage, surface and vertical, have variable intensity.
- **Combination Stage:** rectangular ball bearing with linear measurements to 0.0001" and rotary measurements to 5' with vernier. (Metric model available on special order.)
- **Depth Indicator:** measures in units of 0.0001" by "optical contact" with specimen.
- **Projection Screen:** available as accessory for optical comparison.
- **Eyepiece Turret:** available as accessory for measuring surfaces, radii, thread pitch etc.

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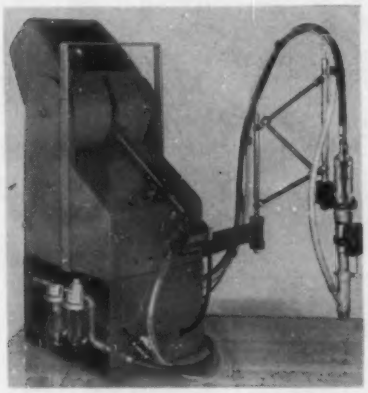
and drill speeds are 100 to 3000, 300 to 1300 and 300 to 1300 rpm, respectively. Motors for the three models are rated at 1½, 3 and 5 hp.

Buffalo Forge Co., Buffalo, N. Y.
Circle 413

Portable Tool Mount Curbs Cross Threading

Available with all standard models of Tru-Tork automatic screwdriving systems, this portable ball-bearing supported tool mount moves laterally at the slightest touch and holds the tool

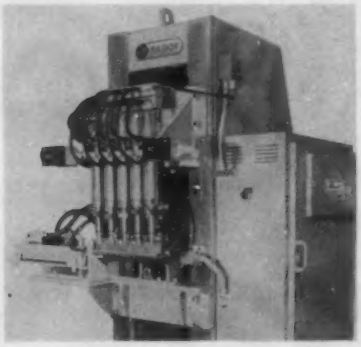


in a vertical position at all times with no side pull. Called Radarm, it reduces the possibility of cross threading when driving screws into pretapped holes. The device also may be used with other tools such as drills, tappers and impact wrenches. It is suited for bench operations or where assembly belts are used in a production line.

Clyde Engineering & Mfg. Co., 937 E. 10 Mile Rd., Madison Heights, Mich.
Circle 414

Interchangeable Components Increase Welder Versatility

Designed with basic universal frames in combination with other standard interchangeable components, this welder meets a wide variety of resistance and



THERE'S MORE TO TAPS THAN MEETS THE EYE!

LET'S FACE IT . . .
You will not notice a major difference when you visually compare the same style standard High Speed Steel, ground-from-the-solid taps made by Jarvis with those made by another quality manufacturer.

They will look alike, measure alike . . . they are made of quality steel. With this apparent similarity . . .

. . . THEN WHAT ARE THE IMPORTANT POINTS TO CONSIDER IN SELECTING TAPS?
Selecting the *right tap for the job* is vitally important for top tap performance. Regardless of its quality, the wrong tap cannot do the job properly. And, as you know, poor tap performance can be costly.

3 KEY POINTS TO REMEMBER
The differences in ground thread taps become apparent in their performance. The key to proper tap selection lies in these three critical areas:

1. Selecting the correct tolerance with respect to tapped hole limits.
2. Selecting the correct type of chamfer, chamfer relief, flute contour and pitch diameter relief.
3. Selecting the style of tap as regards number of flutes, or whether it should be spiral pointed or spiral fluted.

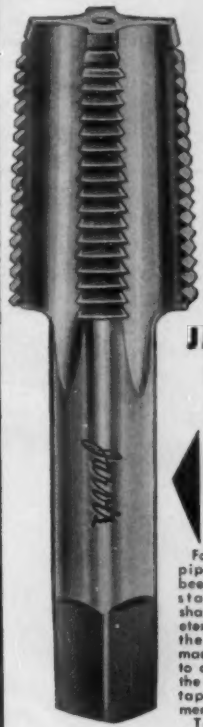
HOW TO GET HELP FOR PROPER TAP SELECTION
Jarvis has gone to great lengths to make tap specifying information available. The new Jarvis Tap catalog has a complete section devoted exclusively to engineering information and guidance for tap selection. Also, Jarvis offers its now-famous, handy pocket-size Tap Selector Guide. Both are free for the asking.

In addition, Jarvis sales-engineers are always ready to help solve your tapping problems.

THERE IS A BIG DIFFERENCE IN TAPS AND IN THEIR PERFORMANCE. YOU CAN PROVE THIS TO YOURSELF BY DEPENDING ON JARVIS THE NEXT TIME YOU ORDER TAPS.

WANT ONE OR BOTH?
- **New Jarvis Tap Catalog** (includes 25-page engineering section)
- Jarvis Pocket-Size Tap **Selector Guide**

JARVIS TAP-OF-THE-MONTH



JARVIS PIPE TAP

NOTE SMALL SHANK

For many years, pipe taps have been made with standard stub shanks. The diameter and length of the stub shank made it difficult to correctly chuck the pipe taps in tapping attachments.

To overcome this problem, Jarvis furnishes ground thread pipe taps, #1716 and #1817, with small shanks (hand tap shank dimensions) in the various American Standard Pipe Forms from stock at regular prices.

Another reason for you to consider Jarvis when ordering taps.

5 JARVIS TAP FACTS

1. Years of experience in the manufacture of High Speed Steel ground-from-the-solid taps *exclusively*.
2. Rigid quality control throughout the manufacturing process.
3. Extensive experience in tapping space age materials.
4. Complete stock of Standards for immediate shipment.
5. Exceptional service on Specials.

Jarvis CORPORATION
- HAND TAPS • NUT TAPS
- MACHINE SCREW TAPS
- TAPPER TAPS • PIPE TAPS • STUB TAPS
- PULLEY TAPS • COLD FORMING TAPS

ALL TYPES OF SPECIALS!

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North Attleboro, Mass.

☐ Send Tap Catalog
☐ Send Tap Selector Guide

Name_____ Title_____
Company_____
Street address_____
City & State_____

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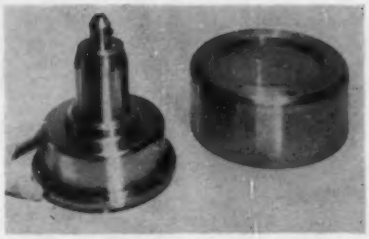
arc welding requirements. It can be adapted for use as a single spot welder, a press projection welder and a combination spot projection press welder. A wide range of throat depths, welding press heads and electrode and die holders can be used. Platens on the multi-spot units can be designed for 2, 4, 6, 8 or 10 air or hydraulic guns mounted in various staggered or in-line spot patterns. Two sizes are available: the UF-56 and UF-96 which will accommodate up to 22-fixture type guns or up to three projection press heads and projection stations.

Kirkhof Mfg. Co., 2450 Buchanan Ave., S. E., Grand Rapids 7, Mich. **Circle 415**

Adapter Triples Spindle Speeds

Consisting of a mounting ring and a spindle and housing assembly, this high-speed spindle adapter triples the

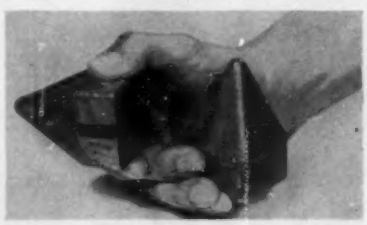


spindle speeds on large vertical duplicating machines by permitting the use of small diameter cutters with shanks up to ½ inch. Model HTL-1 is particularly advantageous in the machining of large workpieces such as casting dies and casting molds. Increased cutter speeds for machines that are usually limited to 1000 rpm eliminate the need to transfer workpieces to smaller machines for fine, small diameter cuts. In addition to the time savings, there is less possibility for errors in location and dimensional accuracy.

Permanent Mold Die Co., 2275 E. Nine Mile Rd., Hazel Park, Mich. **Circle 416**

Blocks Lessen Flame Cutting Maintenance

Costly maintenance of cross supports on flame cutting tables is practically eliminated by Flame-Clear rising blocks. These cast-iron, beehive-shaped blocks fit onto cross supports of any flame



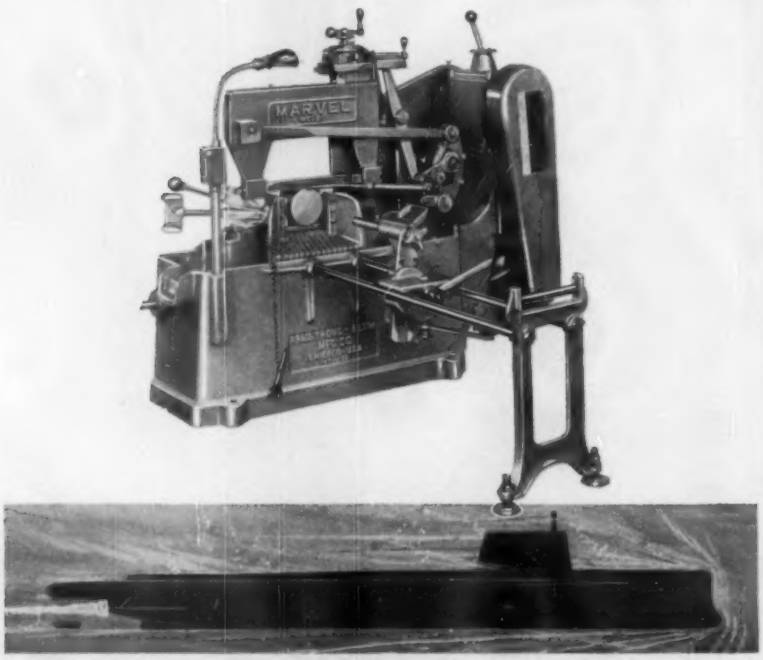
cutting table, holding steel plate clear of the table and preventing the flame from cutting and damaging the table bed. The blocks are available in slot sizes of 5/16 and 3/8 inch.

Brown & Sharpe Mfg. Co., 235 Promanade St., Providence 1, R. I. **Circle 417**

End Mill Grinder Handles Eccentric, Radial Relief

Designed for grinding eccentric or radial relief on end mills and miller cutters having helical teeth, this end mill grinder has a compound angular wheel head with a 50-deg clearance angle adjustment and a 15-deg contact angle adjustment. Its work head has a totally enclosed, reversible indexing

USE READER SERVICE CARD ON PAGE 125 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION



OBSOLETE ?

Emphatically no—not when a Marvel Hack Saw like this one can cut 4600 blanks of 3¼" round 303 stainless steel for just 1½ cents blade cost per cut—not when these 4600 blanks were cut-off at the rate of 20 pieces per hour, floor to floor! And this is typical production performance at that.

Obsolete? This Marvel Hack Saw Machine is as modern in performance as the next atomic powered submarine that will slide down the ways!

If you want faster cutting, the Marvel Hack Saw has speed to spare; accuracy of cut is assured by the rugged construction of the machine itself; blade cost, in many cases is less than 1¢ per cut.

When you consider these advantages and their low initial cost, Marvel No. 6 and No. 9 Series High Speed Heavy Duty Ball Bearing Hack Saws, as we build them, are your best cutting-off equipment buy today.

We can prove our point by demonstrating Marvel Sawing efficiency on your own work, without any obligation on your part. Because we have consistently built both Hack Saws and Band Saws for more than 40 years, we will give you an unbiased recommendation.

Catalog C-60 illustrates and describes the complete line of Marvel Sawing Machines. Write for your copy.

MARVEL Metal Cutting SAWS BETTER MACHINES BETTER BLADES

ARMSTRONG-BLUM MANUFACTURING CO. • 5700 Bloomingdale Avenue • Chicago 39, Illinois

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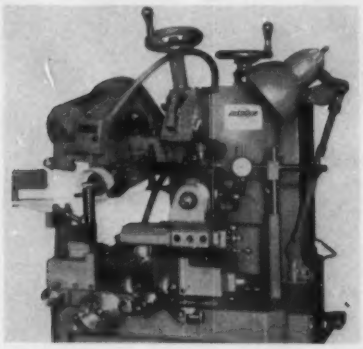
mechanism and a 2-inch hole through the spindle providing a collet capacity of 1¾ inch. An optical parallel gage for setting the teeth of nonradial cutters into indexing position and a wheel head



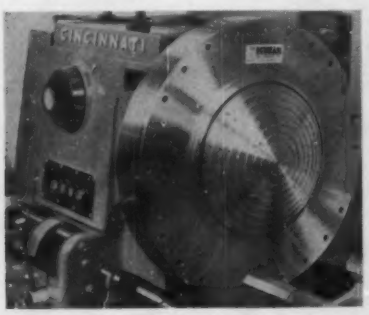
column with a 7-inch travel lateral adjustment are two more features of the unit. Mechanical wheel dressing is performed by three separate, interrelated, diamond wheel dressers.

William H. Field Co., Inc., 323 Dorchester Ave., Boston 27, Mass. **Circle 418**

Chucking System Holds Missile, Aircraft Parts

Activated by a vacuum pump with a hold-down pressure of 12 psi, this chuck was designed for missile and aircraft components such as ceramic nose cones and stainless parts. The chuck—capable of handling parts up to 100 inches in diameter—develops over 33,000 lb of distortion-free pressure on a 60-inch-diam part. An automatic safety device prevents loss of vacuum in case of power failure. Boring, facing and turning

USE READER SERVICE CARD ON PAGE 125 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION



operations are performed concentric within 0.001 inch. Various models are available to fit all rotating type equipment.

Dunham Tool Co., Inc., New Fairfield, Conn. **Circle 419**

Hot-Work Tool Steels

For Every Need

When you need Hot-Work Tool Steels, for standard or severe applications, turn to UDDEHOLM for a superior Swedish quality to satisfy your most exacting requirements. Our mills in Sweden produce grades that have exceptional toughness, will retain high hot-hardness and resist heat-checking, to give long production runs.

Specify these grades for economy with UDDEHOLM Swedish Quality!

For Brass and other high-temperature alloy Die Casting, Hot Press Forging and Hot Extrusion Dies — UDDEHOLM'S exclusive **UHB CALDUR** • **UHB CALMAX**
For Aluminum, Magnesium, long-run Zinc Die Casting — **UHB ORVAR** — SAE H-13
For Aluminum Hot Extrusion Operations — **UHB SPECIAL** — SAE H-12
For Zinc Die Casting — Cold Hobbed Dies — **UHB PREMO** — SAE P-4

UDDEHOLM Tool Steel Service Centers stock
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one piece stainless steel spindle

HARDENED AND GROUND FROM THE SOLID

- Reads to .0001" • Heavy duty tungsten carbide measuring faces
- Forged frame • Dull chrome finish on thimble and barrel
- Quick acting positive lock • Built for accuracy under the most rugged applications • Furnished in handsome contour case

AVAILABLE INDIVIDUALLY OR IN SETS FROM 0 to 12"
WRITE FOR CATALOG on complete line of precision measure instruments

ALINA CORPORATION

122 East Second St., Mineola, L. I., N. Y.

Use Reader Service Card, CIRCLE 105

J. WALTER REX tells why he chose Lindberg equipment for his new Florida plant

QUOTE from Mr. Rex

"When we designed our new plant, Rex of Florida, Inc., we made sure we could provide the Florida metal working industry with complete heat treating services. After carefully surveying the industrial activities we would serve we knew we would be called upon to offer scientifically controlled, high quality heat treating for a variety of metals, both ferrous and non-ferrous, and an unusual diversity of sizes, shapes and weights. Our long experience with Lindberg furnaces and atmosphere controls assured us that we could depend on Lindberg equipment to help us meet most efficiently the widely varying demands of our Florida customers."

J. Walter Rex, President, Rex of Florida, Inc., Fort Lauderdale, with Lindberg high temperature, all-purpose furnace, one of six Lindberg units specified for this new plant. Mr. Rex, also President, J. W. Rex Company, Lansdale, Penna., is recognized as one of the foremost metal working authorities and his commercial heat treating operations are among the largest and most important in the country, particularly in treating components for rockets and missiles.

Latest Rex purchase from Lindberg—new vacuum furnace for Lansdale, Penna., plant

Mr. Rex's confidence in the ability of Lindberg equipment to meet the most exacting commercial heat treating requirements is based on the years of efficient and dependable service rendered by Lindberg units in his commercial heat treating operations. He has been a Lindberg customer for nearly 20 years. We're glad that he has found our equipment so satisfactory. We're very well satisfied with Mr. Rex as a customer, too. Altogether, including the units for Rex of Florida, Inc., he has purchased 34 Lindberg units over the years.

Lindberg offers the most complete line of fuel-fired and electric furnaces and equipment for heat treating ferrous and non-ferrous metals available to industry. If you have any problem in heat treating, get your local Lindberg representative's help now. You can depend on his experience and Lindberg's engineering and design know-how to provide exactly the right equipment for your need. And it's easy, too! Just call your Lindberg Field Engineer (he's listed in your classified phone book) or write us direct. Heat Treating Furnace Division, Lindberg Engineering Company, 2447 West Hubbard Street, Chicago 12, Illinois.

Los Angeles plant: 11937 S. Regentview Avenue, Downey, California. In Canada: Birlefco-Lindberg Ltd., 15 Pelham Ave., Toronto 9, Ont. Also, Lindberg plants in Argentina, Australia, England, France, Italy, Japan, Spain, Switzerland and West Germany.

LINDBERG
heat for industry

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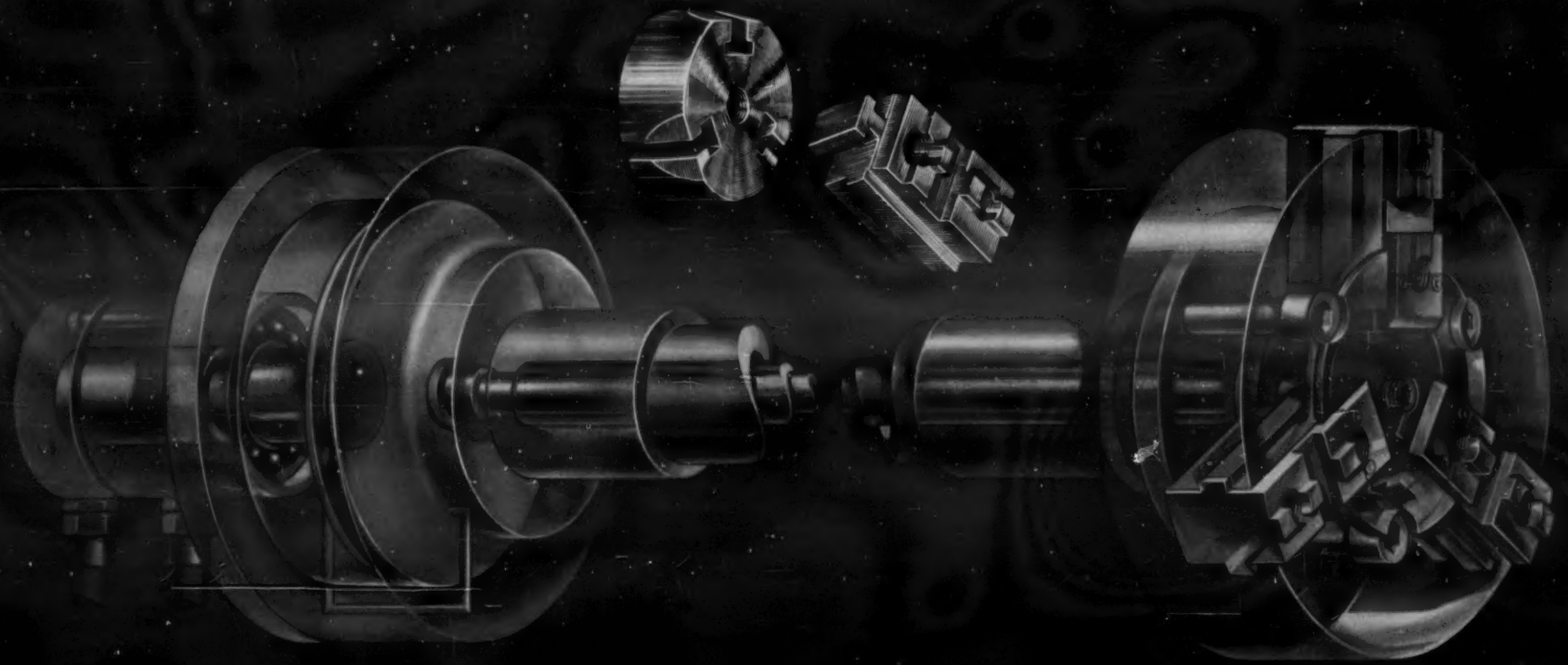
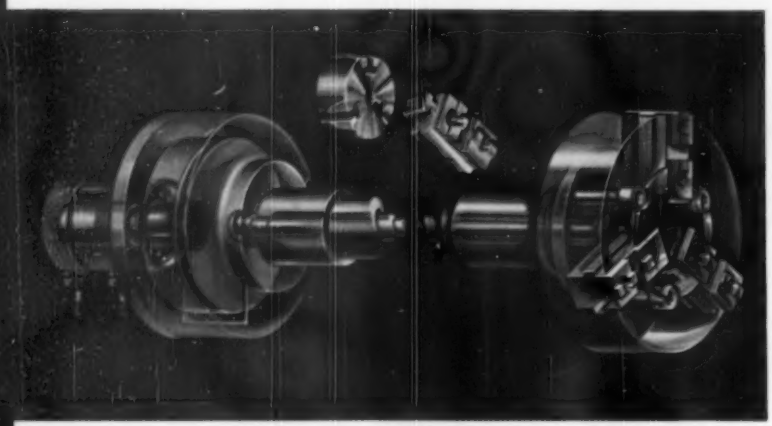
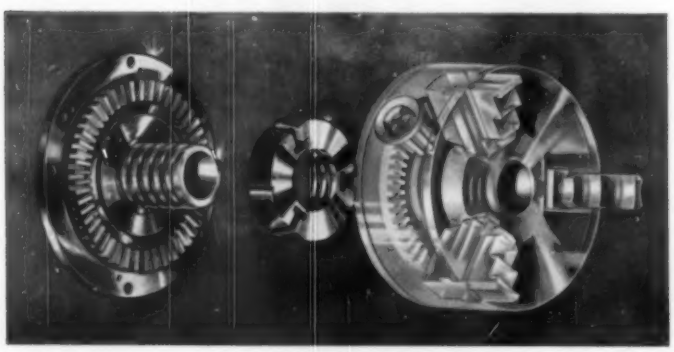
SKINNER PACKAGED POWER CHUCKING ASSEMBLY



Typical major chuck developments that come to you from SKINNER



Packaged power chucking assemblies are available for Atlas, Cintilathe, Hardinge, Logan, Regal, Sheldon, South Bend, and many similar lathes. Assemblies are also available for Brown & Sharpe and similar automatic and hand screw machines to permit chucking of cold drawn parts, small or odd shapes and castings. Packaged assemblies consist of chuck with two or three jaws, threaded drawbar and drawtube, rotating air cylinder, cylinder adaptor and necessary mounting for the individual machine.



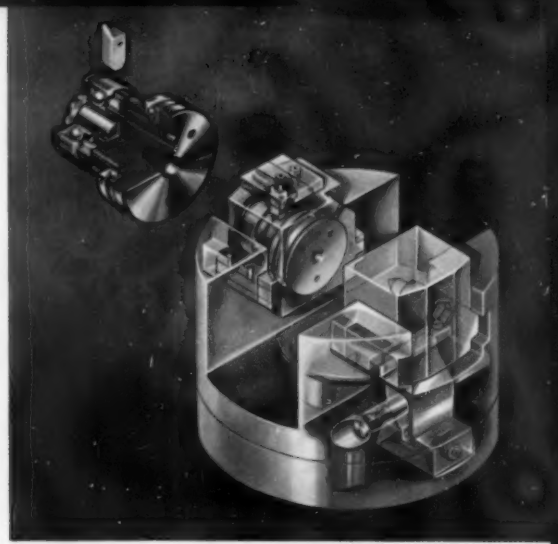
Extra-heavy-duty Wedge-Screw chuck combines best features of power and hand chucks. It develops tremendous gripping power, high accuracy and repeatability by a unique principle. When the lug-type pinion is turned manually or by a power wrench, it engages the gear plate causing the screw to move the wedge. The force of the wedge on the jaws holds the work with tremendous power.

This Wedge-Screw chuck has such useful features as:

Accuracy—within .001 total indicator reading
Repeatability—within .0005 total indicator reading
Complete Range—no size limitation

Many other features including over-tightening and operator protection, sealed operating mechanism, automatic lubrication, etc.

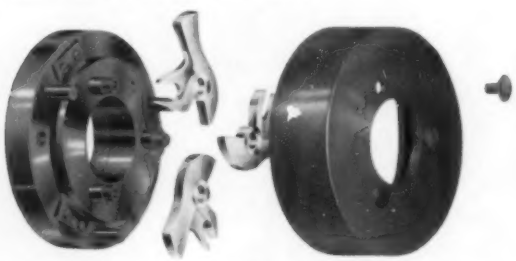
For complete details about packaged power chucking assemblies, indexing chucks, wedge-screw chucks, +GF+ Work Drivers, other chucks and chuck equipment, contact your Skinner Representative or Distributor, or write us at the address below.



Heavy-duty power chuck with jaws that index freely under full pressure. Indexing is simple, easy, and fast. The operator can index manually without touching the work or releasing the pressure. Jaws are indexed by means of a lock screw and slide plate. Note the size and shape of the indexing pin. It fits firmly and positively into the indexing plate so that extreme accuracy of indexing is assured.

One or both jaws can be furnished with indexing mechanisms. As a result, you can index more positions and smaller index angles. There is no need to buy a new chuck for different indexing positions because index jaws or index components can be interchanged quickly and easily.

This new Skinner chuck is available in all body diameters from 12″ through 36″.



+GF+ Work Drivers distributed by Skinner, are the best clamping devices available for driving rough or smooth blanks between centers. Eccentric jaws with floating spring action hold firm, and any increase in cutting tool pressure and/or spindle speed automatically increases the holding power of the work driver. The jaws are easily reversed to accommodate changed direction of spindle rotation.

The protective hood covers all mechanism and provides means of manually opening and closing jaws. A slight turn of the hood, with surface cross-hatched for sure grip, opens jaws and holds them open until work is placed between centers—another turn releases jaws to grip work. **+GF+** Work Drivers are available to hold work ranging in diameter from $1\frac{1}{32}$″ to $8\frac{1}{16}$″.

Maximum eccentricity of any piece is $\frac{5}{32}$″. Finished adaptor plates or rough castings are available for mounting on all types of machines.

SKINNER CHUCKS®

THE CREST OF QUALITY

SKINNERCHUCKS

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Field Notes

CORNELL UNIVERSITY is the recipient of a $4,350,000 grant made by the **Ford Foundation** to further strengthen graduate study and research in the College of Engineering. The grant will contribute toward the endowment of 11 professorships. It will also help provide substantial graduate fellowships and loan assistance, additional facilities for study and research, and will make other funds available for special purposes. The grant will cover a period of 10 to 15 years.

Western Reserve University's Documentation Center in cooperation with **General Electric Co.** and the **American Society for Metals** unveiled its new Information Storage and Retrieval System at a press conference on May 24. Designed to provide ready access to all published information on metallurgy, the System utilizes a GE 225 all-purpose computer and a special method of programming developed at the Center. Because this type of programming—key punching of cards in a semantic language and feeding them to the machine—can be adapted to disciplines of any type, the System is regarded as a break-through in the evolution of library science.

acquisitions

Bendix Foundries of **Bendix Corp.** has completed negotiations with the U. S. Government to purchase land, buildings and certain equipment it had previously rented from the Navy for the production of magnesium, sand and nonferrous die castings. The company acquired two buildings with a total of 135,000 sq ft of floor space and 8½ acres of land. The Bendix facilities are completely mechanized and have complete nondestructive testing facilities. Processes include die, sand, permanent mold, shell mold, plaster ceramic and centrifugal castings.

A. O. Smith International S. A., subsidiary of **A. O. Smith Corp.,** Milwaukee, Wis., has announced finalization of an agreement in which it acquires 40 percent ownership of **Manufacturas Metalicas Monterrey,** S. A. D. J. O'Connell, president, indicated that the first products to be introduced into the Monterrey, Mexico, production schedule will be automotive truck components.

Hoffman Industries, Inc., a subsidiary of **Hoffman International,** has acquired the **Air Appliance** and **Filtration Divs.** of **U. S. Hoffman Machinery Corp.** Under the terms of the acquisition, both divisions remain under the same operating management with the Air Appliance Div. headquartered at 103 Fourth Ave. in New York City, and the Filtration Div. offices in Syracuse, N. Y. Products of the first division include centrifugal air blowers and exhausters, portable and stationary industrial vacuum cleaning systems, pneumatic conveying equipment and continuous metal, rubber, glass and plastic strip sheet dryers. The Filtration Div. manufactures individual and central systems for the clarification, filtering and reclaiming of oils, solvents and industrial waters employed in metalworking.

Bancroft-Hickey Mfg. Co., Bristol, Pa.—recently acquired subsidiary of **American Chain & Cable Co., Inc.**—has purchased all of the outstanding capital stock of **Victor Inc.,** Paoli, Pa. Victor, Inc., manufactures diamond blades and masonry saws for masonry and concrete cutting operations under the trade names of Victor, Valor, Valsafe and Di-Namic. Bancroft-Hickey manufactures grinding wheels and other abrasive products.

Boice Gages, Inc., Hyde Park, N. Y.—manufacturers of precision measuring instruments—has acquired the **Reli-A-Chek Corp.,** gage manufacturer, of Santa Maria, Calif. According to Ralph A. Boice, the subsidiary company will be renamed **Reliant Gages, Inc.** William J. Kassen, president of Reli-A-Chek Corp., will become president of the acquired company.

Beloit Tool Corp., Beloit, Wis., has announced the purchase of the **Walter T. Cole Tool Co.,** Scottsdale, Ariz. They will operate the company as a wholly owned subsidiary corporation. Cole Tool manufactures solid carbide tools designed for use in highly abrasive and other special materials, while Beloit manufactures high-speed steel special taps and special thread gages.

mergers

David B. Pall, president of **Pall Corp.,** Glen Cove, N. Y., has announced a merger with **Trinity Equipment Corp.** of Courtland, N. Y. Trinity, a producer of dry air and gas systems, thermowells and thermocouples, will continue as a wholly owned subsidiary of Pall. A substantial expansion of development and engineering activities is planned for the firm, both at Courtland, where the existing engineering and development staff will be enlarged, and at Glen Cove.

new activities

Powertron Ultrasonics Corp. has announced the formation of a wholly owned division, **Powertron New England** as successor to **Industrial Ultrasonics, Inc.,** an independent distributorship absorbed by Powertron. The new division, headed by Theodore M. Jordan, president, will stock a complete line of Autosonic cleaners and processing equipment.

The formation of **Zero Research Laboratories** as an operating division of **Zero Mfg. Co.** has been announced by president John B. Gilbert. Formed to provide research and development and production for all types of metal joining, welding and epoxy bonding, the division already has several classified projects in research, development and furnishing prototypes for the Hawk, Minuteman and Sidewinder missile programs.

As part of a planned diversification program in its general field, **Detroit Broach & Machine Co.,** Rochester, Mich., has acquired exclusive licensing rights to a system of hydraulic control for small and large plants engaged in machining operations. As a result of the acquisition, the company has formed a new sales division, under the direction of S. R. Cudnohufsky, the inventor and developer of the system. The division will immediately market a production-tested unit that makes use of the system to convert almost any machine tool in use to a high precision, tracer machine for handling either short-run or high-volume production.

Ralph F. Peo, chairman of the board and president of **Houdaille Industries, Inc.,** has announced that a long term license agreement has been successfully negotiated with **Kearney & Trecker—C.V.A., Ltd.,** of Sussex, England. The agreement provides for the manufacture by Kearney & Trecker of the Wales-

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R.S.V.P.
EMHART MFG. CO.
HUDSON DIVISION
HUDSON, N.Y.

EMHART

IN INVITING YOU TO TAKE OUR COURSE . . .

May we stress that, while we make precision V&O presses, feeds and automatic assembly machines, we are really in the business of helping you effect cost reductions in small parts production.

You can take our course by simply asking us to have the Emhart man in your area call on you. He is prepared to discuss cost reduction in the following areas . . .

1. PRODUCT DESIGN
2. MATERIAL AND PARTS FLOW
3. PACKAGING
4. FABRICATION
5. ASSEMBLY
6. DIRECT LABOR
7. INDIRECT LABOR
8. METHODS SIMPLIFICATION (People)
9. METHODS SIMPLIFICATION (Machines)
10. QUALITY CONTROL
11. IN-PROCESS INVENTORY
12. MAINTENANCE
13. FLOOR SPACE
14. SPARE PARTS INVENTORY (Customer)
15. SPARE PARTS INVENTORY (V & O Machines)
16. CRITICAL OPERATIONS

V & O
AUTOMATIC
PRESSES
AND FEEDS

Field Notes

Strippit line of self-contained punching and notching units used in the sheet metal industry, and Wales-Strippit Hydrasprings which are patented devices that perform a spring action using the principle of compressible liquids for distribution in England, Scotland, Wales and Northern Ireland.

association news

New president for 1961-62 for the **American Society of Lubrication Engineers** is Dean M. Cleaveland, Bendix Corp., South Bend, Ind. The vice president-at-large is L. B. Sargent, Jr., Aluminum Co. of America, Pittsburgh, Pa. W. E. Hoch, Viscosity Oil Co., Chicago, Ill., was re-elected treasurer and A. E. Cichelli, Bethlehem Steel Corp., Bethlehem, Pa., was re-elected secretary.

F. R. Jeffrey has been elected president of the **American Zinc Institute.** He is president of National Zinc Co., Inc., New York City. Other officers elected were three vice presidents: J. J. Lennon, American Metal Climax, Inc., New York City; C. E. Schwab, Bunker Hill Co., Kellogg, Idaho; and H. L. Young, American Zinc Sales Co., St. Louis, Mo. Re-elected were G. H. LeFevre, U. S. Smelting Refining and Mining Co., New York City, as treasurer, and J. L. Kimberley, executive vice president and secretary.

Bernard Kearney has been re-elected president of the New York-New Jersey branch, **National Metal Trades Assn.** He is president of Torsion Balance Co., Clifton, N. J., manufacturer of torsion and analytical balances. Other officers also re-elected for 1961 were vice president, Mark A. Feiner, P. Feiner & Sons, Inc.; and treasurer, John F. Biehl, Jabez Burns & Sons, Inc., both of New York City.

A. F. Chouinard, director of research and development, National Cylinder Gas Co., has been elected president of the **American Welding Society.** Chouinard has designed many types of welding and cutting equipment, is the holder of 20 patents, and is now responsible for the development and application of all the company's products and processes.

W. Arthur Irvine, manager of production engineering of Maytag Co., Newton, Iowa, has been elected president of the **Metal Powder Industries Federation,** succeeding George A. Roberts. Other officers include Kempton H. Roll,

NEW!

KNOW YOUR SPEED
with the accurate
SERVO-TEK SPEED INDICATING SYSTEM

A truly versatile "package" provides accurate speed indication for almost anything that moves. Nearly every industrial process or machine can benefit by the economy and safety of continuous speed indication.

FEATURES

SELF-POWERED No batteries or external power required.

LOW VOLTAGE Connecting cable can be as long as 500 ft.

PERMANENTLY LUBRICATED BALL BEARINGS.

EASILY READ 4½" INDICATOR Damped to withstand vibration and shock.

STANDARD RANGES 0 to 100, 250, 500, 1000, 2000, 3000, 4000, 6000, 8000, 10,000 and 12,000 RPM. These speeds can also be provided to read "Percent of Full Speed" or "Percent of Capacity." 0 to 10 RPM available at small additional cost.

$87.00 includes generator, indicator (specify range), mounting base, coupling, and 15 ft. of electrical cable. Delivery from stock. Quantity discounts.

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PRODUCTS CO.

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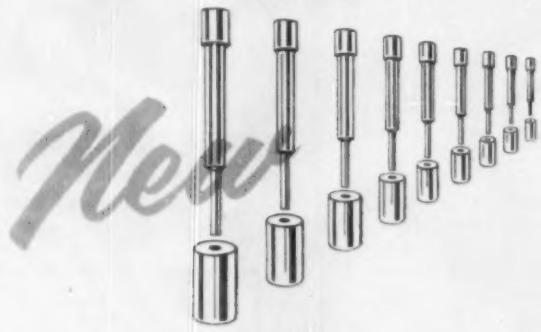
reappointed executive secretary and treasurer; Robert C. Burgess, elected president of the Powder Metallurgy Parts Manufacturers Assn.; Paul J. Failla, named vice president, succeeding Burgess; and William L. Strawbridge, elected treasurer, succeeding Gerald G. Fellows of American Powdered Metals, Inc. Earl Lowe was elected president of the Metal Powder Producers Assn.; Peter V. Schneider, president of the In-Plant Powder Metallurgy Assn.; Norbert K. Koebel, president of the Powder Metallurgy Equipment Assn.; and John C. Webb, president of the Metal Powder Core Assn., succeeding Benjamin Falk.

The election of 1961-62 officers has been announced by the **Steel Service Center Institute's** executive vice president, Robert G. Welch. Named to the two top posts were Ralph W. Shaw, Jr., president of A. R. Purdy Co., Inc., Lyndhurst, N. J., who becomes chairman of the executive committee, and Robert J. Heggie, president of A. M. Castle & Co., Chicago, Ill., who will serve as institute president. Joseph H. Roberts, Jr., president, Edgcomb Steel of New England, Inc., Milford, Conn.; and N. F. Korhumel, president of Korhumel Steel & Aluminum Co., Evanston, Ill., were elected vice presidents. New treasurer of the organization is M. R. Lowenstine, Jr., executive vice president and treasurer of Central Steel & Wire Co., Chicago, Ill.

New officers for the **American Society for Engineering Education** are Dr. Robert W. Van Houten, president; vice presidents, Dr. George A. Marston and Dr. Curtis L. Wilson; and treasurer, Wendel W. Burton. Dr. Van Houten is president of the Newark College of Engineering and director of the Newark Technical School. Marston serves as dean of engineering at the University of Massachusetts and Dr. Wilson, dean of the Missouri School of Mines and Metallurgy. Burton is with the Minnesota Mining and Manufacturing Co.

NEW! NEW! NEW! NEW! NEW!



NEW! NEW! NEW!

CARBIDE Standard PUNCHES and DIES

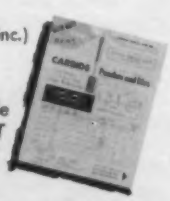
FROM STOCK . . . LOW COST . . . HIGH PERFORMANCE—All the red tape and high inquiry cost is eliminated when you order carbide punches and dies from Oberg's Standard Pricing Sheet. The standard punch or die you need is shipped right from stock . . . no delays! . . . and the price per unit is low!

Punches are stocked in standard point sizes from .060" to .374" together with corresponding die bushings . . . all made to the high quality and precision standards established by Oberg and recognized everywhere.

Need carbide standard punches and dies right now? Call or write Oberg! You'll like the service!

Oberg is something special

Oberg CARBIDE PUNCH AND DIE, INC.
FREEPORT, PA.
(A Division of Oberg Manufacturing Co., Inc.)



Send today for New Carbide Standard Punch and Die PRICE LIST effective June 26, 1961

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awards

Lief J. Sverdrup, president and director of the engineering firm of Sverdrup & Parcel, Inc., has been selected to receive the 1961 **National Society of Professional Engineers** award for outstanding service to the engineering profession. The award cites Sverdrup for "his acumen, sound judgment and ability as an engineer executive; his patriotism, valor and meritorious service to his country as an engineer soldier; his constructive, distinguished and unselfish public service to his fellow man as an engineer citizen; and his talents, competence and leadership as a professional engineer."

expansions

Extremultus, Inc., a West Germany producer of power transmission belting, will house its new United States manufacturing facilities in a new plant at 130 Coolidge Ave., Englewood, N. J. The friction surface of Extremultus belting is chrome-tanned leather bonded to a flexible, oriented nylon-polymer core, thus combining the strength and elasticity of the polymer core with a leather having a higher coefficient of friction.

In a major expansion of its export sales and service, **Scully-Jones and Co.**, Chicago manufacturer of standard and special production tools, has formed a new organization, **Scully-Jones International, S. A.** Central office is located in San Juan, Puerto Rico, under the presidency of L. H. Skoglund, Jr., and

the management of Lloyd J. Hughlett. The company has also licensed **Koroda Gauge Mfg. Co., Ltd.**, Tokyo, Japan; **Sutton Tool & Gauge Mfg. Co., Pty, Ltd.**, Melbourne, Australia; and **B. O. Morris, Ltd.**, Coventry, England, to manufacture and sell Scully-Jones tools.

Company president, H. Dale Long, also announced the appointment of several U. S. firms as representatives handling the full line of Tychoway recirculating roller bearings and Super-Cision recirculating ball screw screws. They are **Pacific Bearings Co.**, Los Angeles, Calif.; **Bearing Sales & Service, Inc.**, Seattle Wash., and Portland, Ore.; **Bearing Engineering Co.**, San Francisco, Calif.; **Special Products Div., Production Service Co.**, Cleveland, Ohio; **Benson Engineering Co.**, Dallas, Tex.; **Southern Tool Distributing Co.**, Atlanta, Ga.; and **Automation Components, Inc.**, Maplewood, Mo.

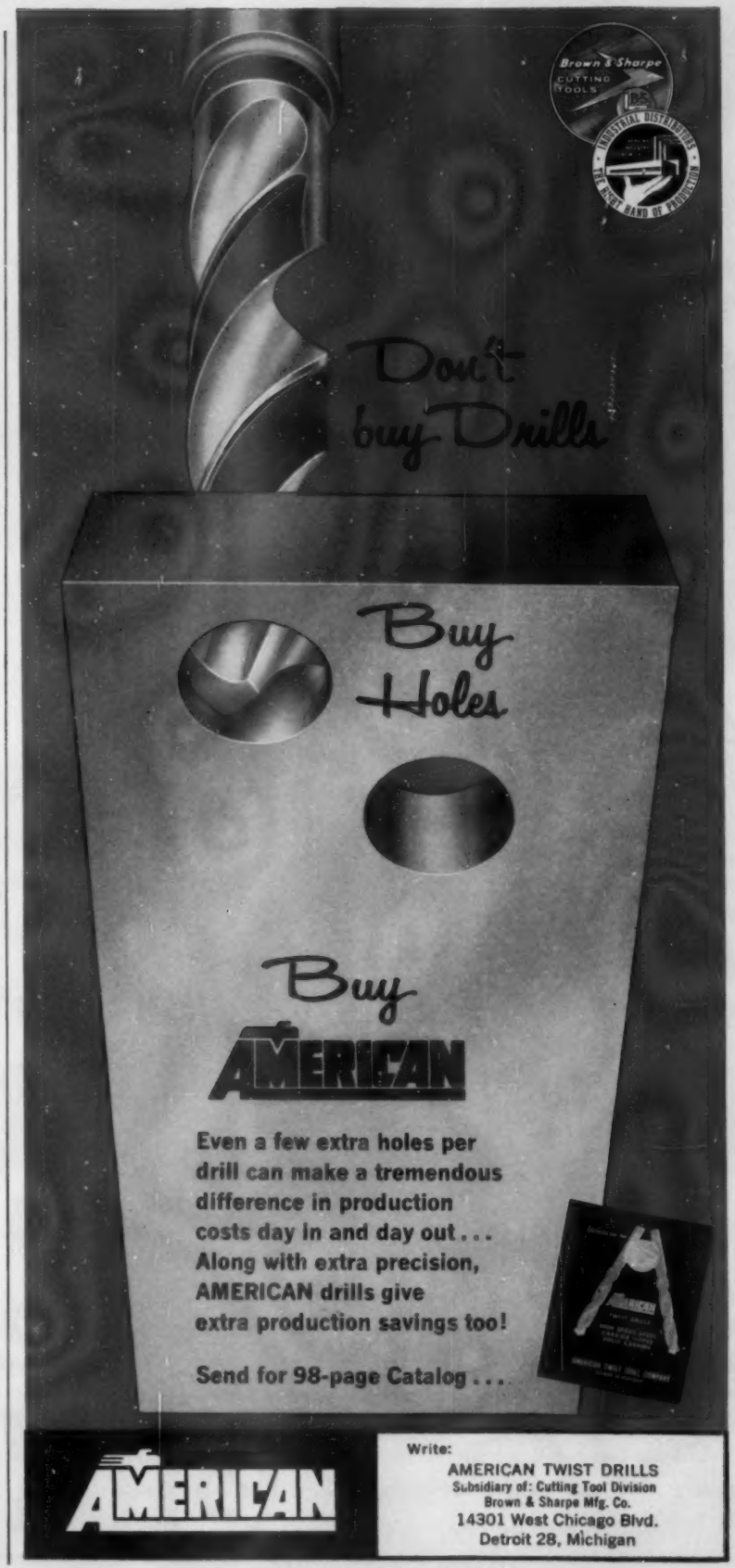
name changes

A trade name in the metals industry for 45 years—**Western Brass**—is being changed in the interests of simplicity, uniformity and closer identification with **Olin Mathieson Chemical Corp.**, which makes the brass. The new name is **Olin Brass**, the company announced.

The board of directors of **Smith Welding Equipment Corp.**, Minneapolis, Minn., has announced a new corporate name, the opening of a new division and a change of officers. It will become a division of **Tescom Corp.**, as will a new fluid systems division informally activated Jan. 1 of this year. Elmer H. Smith became honorary chairman of the board and new board chairman will be L. L. McBurney, who steps up from the presidency. Moving into the top management spot as the new president will be Jack E. Smith, formerly executive vice president. G. O. Swenson will be secretary.

new facilities

A new plant for applying Flame-Plate coatings is in full production at North Haven, Conn., according to W. B. Nicholson, president of **Linde Co., Div. of Union Carbide Corp.** Flame-Plating, introduced in 1953, is Linde's patented process by which coatings or hard substances such as tungsten carbide and aluminum oxide are applied to parts made from a variety of base metals and most other materials, including glass, providing them with increased resistance to wear, abrasion, erosion and corrosion.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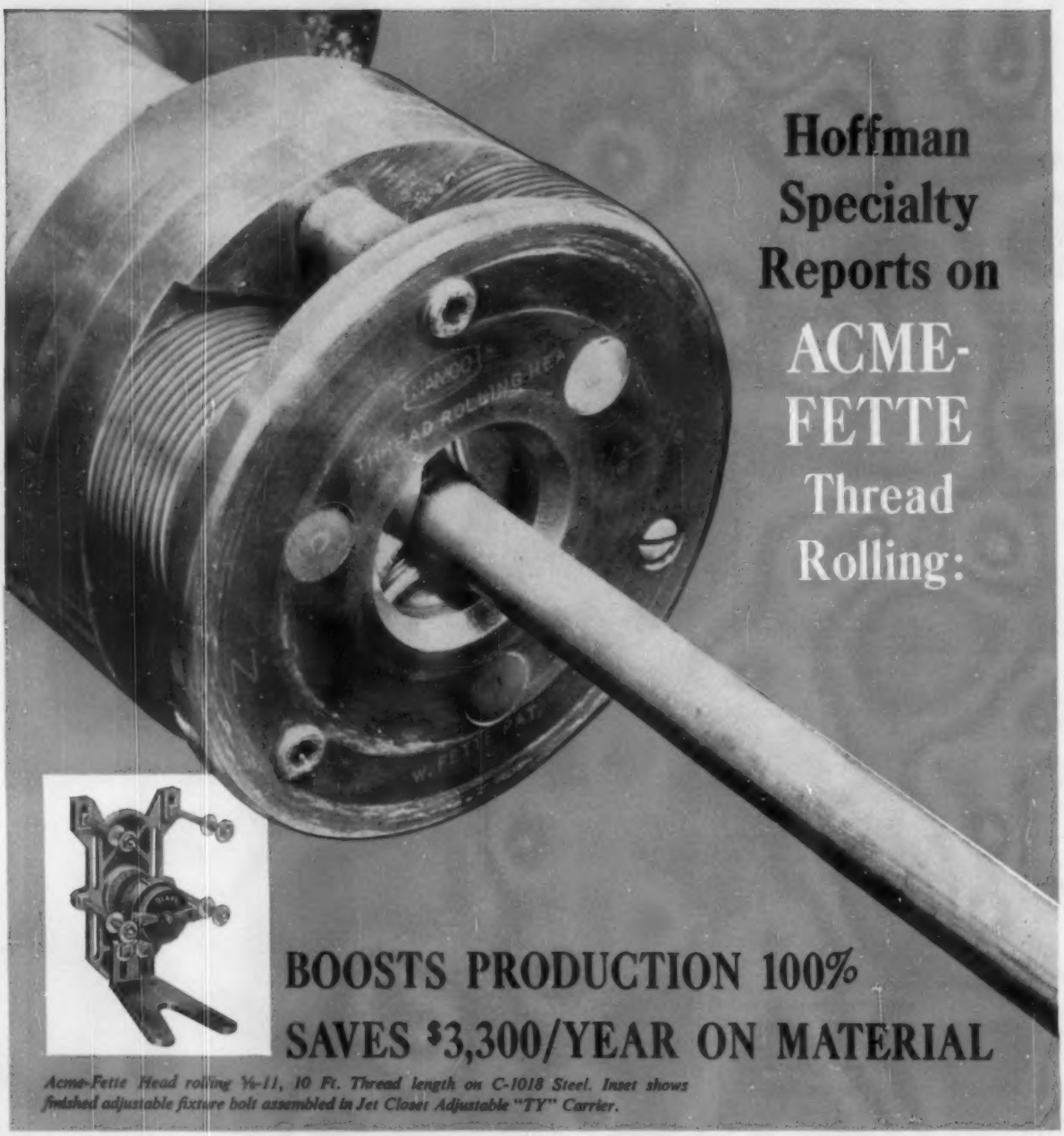

Acme-Fette Head rolling ½-11, 10 Ft. Thread length on C-1018 Steel. Inset shows finished adjustable fixture bolt assembled in Jet Closet Adjustable "TY" Carrier.

"Doubled production . . . saved us $3,300 on material alone . . . rolled over sixteen *miles* of thread with same set of rolls . . . produced stronger, more easily-assembled threads with finer finishes . . ." This is the Blake Division of Hoffman Specialty Manufacturing Corporation describing a year's operation with an Acme-Fette N-3 Self-Opening Thread Rolling Head. Such superior performance is easily explained: Because the Acme-Fette Head generates the thread progressively from the front of the rolls, metal flows to the thread's full depth eliminating broken grain structure and cratering at the thread crest. The result is a thread with a high grade burnished surface, remarkably resistant to wear and corrosion. And, Acme-Fette Heads roll any parallel or tapered thread from 1/16" to 2" up to *5 times faster* than thread cutting tools. Get full details. Send for Bulletin NAF-57A.

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technical shorts

New Water-Soluble Oil—Replacement of straight oils with water-soluble oils in metalcutting operations has been announced by the Van Straaten Chemical Co., Chicago. Resulting from a special research project, the new specially formulated water-soluble compound has effected cost reductions in numerous metalcutting and grinding operations. It is expected that the compound will be capable of use in 95 percent of the applications now requiring straight oil. Initial performance of the compound in a number of plants throughout the country shows increases in production and tool life ranging as high as 100 percent. Because of its lubricating properties and its wetting abilities, the compound has been used successfully in broaching, form grinding, milling, drilling, hobbing, tapping, gear shaping and slotting operations which normally require straight oil.

Aluminum Alloy—Development of Precedent 71, a high-strength shock-resistant casting alloy similar in characteristics to Almag 35 has been announced by William F. Jobbins, Inc., Aurora, Ill. Principal use of the alloy is in applications requiring high yield strength and low elongation. In the as-cast condition and aged at room temperature, it develops a high combination of physical properties. Without heat treatment, these properties are superior to those of most conventional aluminum casting alloys after they have been solution heat treated.

Improved Casting Technique—Development of a new mold-making process that permits mass production of high-quality, high-precision metal castings at costs competitive with the crudest of foundry techniques has been announced by the Shaw Process Div. of Avnet Electronics Corp., Port Washington, N. Y. Central feature of the conversion of Shaw Process from a specialty to a mass-production method is the development of a composite mold consisting of a low-cost sand backing with a special ceramic facing—both reclaimable—which substitutes for the solid ceramic mold previously used. Increased efficiency also results from a streamlining of the vital bakeout step. Reduced from a four or five-hour period to a matter of minutes, this eliminates expensive oven equipment and permits a straight-line, mass-production setup.

Portable Positioners—The aircraft industry is now using hydraulic positioners to reduce fixture-setting time by as much as 80 percent. Under development for three years by Lockheed's California Div., the positioners are now being marketed by the Special Products Sales Unit of the California Div. Lockheed used the new tools to help build virtually all major jigs required to produce the P3V-1 Orion, an antisubmarine warfare airplane now being manufactured for the U. S. Navy.

Drilling Heat Exchangers—New techniques in deep-hole drilling developed by 20th Century Machine Co., Utica, Mich., make drilled-from-the-solid heat exchangers practical in applications where they could not previously be specified. Through use of the technique holes can be drilled to greater depths—up to 20 feet—with better finish and less runout than has been possible in the past. Cost of drilling most panels has also been materially reduced by multiple drilling on ½, 1 and 2-inch centers.

Drilled-from-the-solid heat exchangers can be produced in stainless steel, aluminum and other metals for plating, chemical batching, hot pressing and other industrial processing operations. They can also be obtained in sizes impossible to produce in laminated design because of brazing-furnace limitations.

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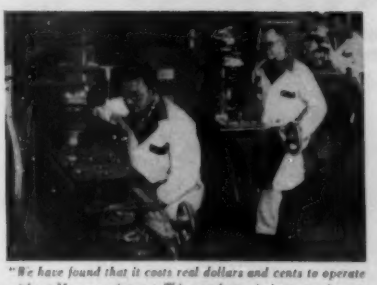

"We have found that it costs real dollars and cents to operate without Moore equipment. This cost factor is just one of many reasons why we recently added the new Moore Model No. 3 Jig Grinder. This Machine, with its tenth-splitting accuracy, hardened ways and wider range, enables us to service more customers better." Statement by Val Koller, President, Koller Die & Tool Co., Milwaukee, Wisconsin.

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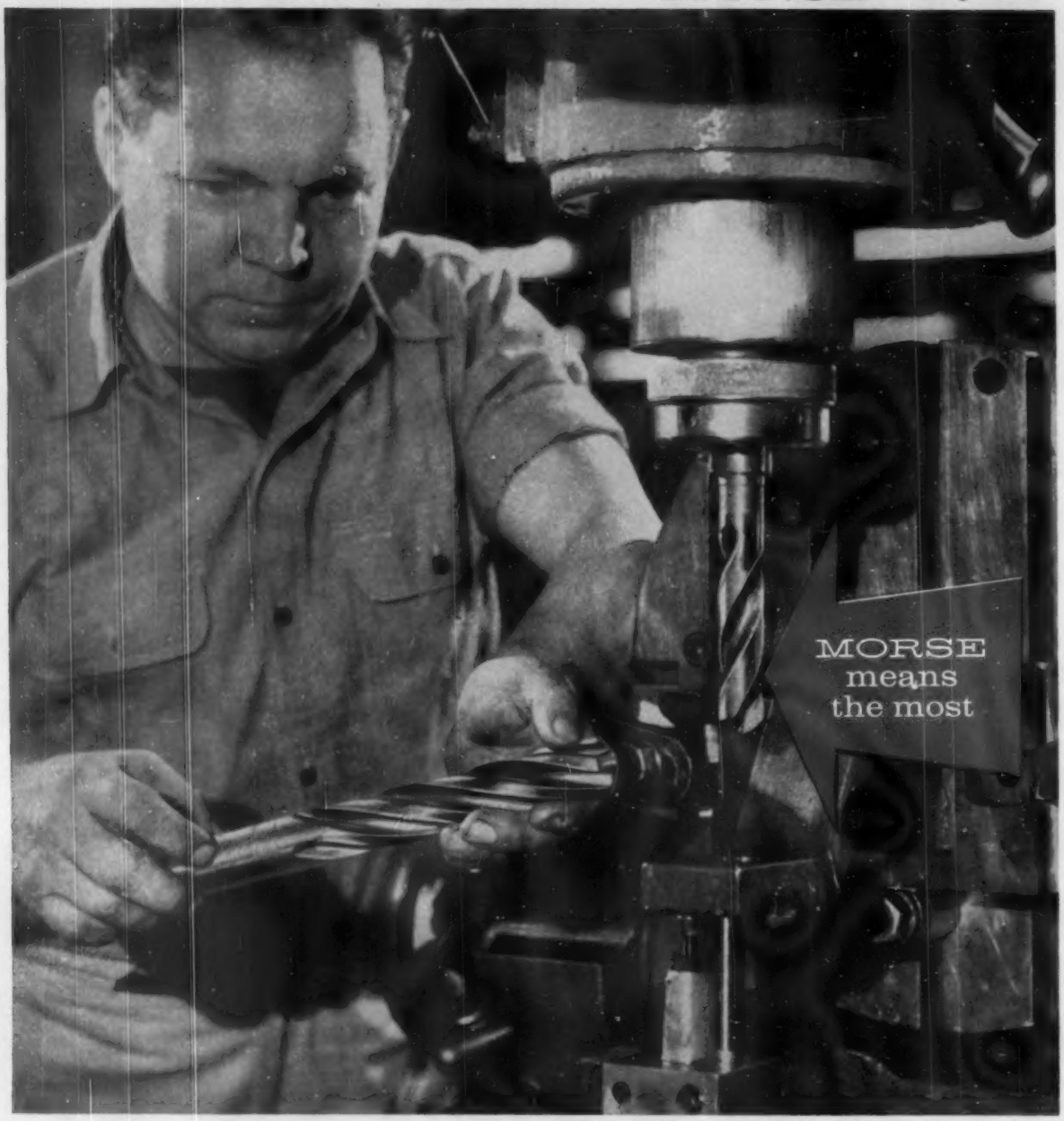

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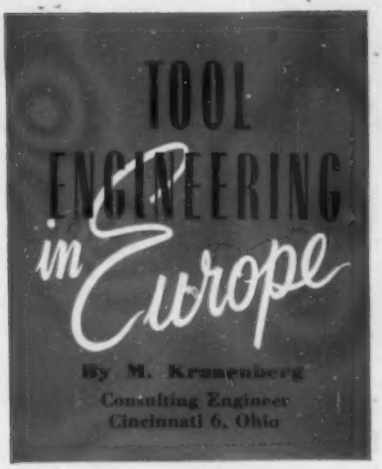

Drawing Rectangular Shapes

While formulas for drawing force and stress for circular workpieces have been in use for some time, none have been available for the drawing of rectangular workpieces. In an article in *Werkstatt Technik*, Vol. 51, No. 4, 1961, p. 167-173, W. Dutschke describes investigations made for the purpose of developing such formulas. Appropriate equations and their derivations are included in his article, which is entitled "Ueber das Tiefziehen rechteckiger Teile."

Dutschke introduces a "fictitious diameter" that makes it possible to apply formulas similar to those used for circular pieces to rectangular pieces. This fictitious diameter can be roughly described as the mean of the circumscribed and inscribed diameters. It can be accurately calculated with formulas that appear in the article.

Drawing force, Dutschke points out, is the resultant of several components, including the force of deformation of the metal, friction forces at the blank holder and elsewhere, and spring-back force.

The drawing force for elliptical pieces can be computed in the same way as for rectangular pieces. Although tests for other shapes have not yet been run, Dutschke feels that the same method can be used as an approximation for numerous other shapes.

In Dutschke's method, the drawing ratio, which is the ratio of the diameter of the circular blank to the diameter of the drawing punch, is modified into the ratio of the fictitious diameters of the blank and drawing punch. Their maximum—a determining factor in the rupture of sheet metal—is independent of the drawing speed but is affected by the thickness of the material to be drawn. Geometrically similar workpieces have similar drawing stresses, hence similar drawing ratios.

Dutschke also describes tests run to determine where maximum stress occurs during the drawing process—a significant factor when selecting the type and power of a drawing press for a specific operation. Using the fictitious diameters, he finds that the maximum stress occurs at about one-third of the total depth of draw. This agrees with the conditions existing when circular pieces are formed.

Optical Positioning

High magnification and elimination of measuring errors—common in the case of mechanical positioning devices—are among the advantages of optical instrumentation for the positioning of slides, carriages and other machine tool elements. An article published in *Werkstatt und Betrieb*, Vol. 94, No. 1, 1961, p. 35-39, deals with optical equipment recently developed for this purpose. The title of the article is "Positionieren von Werkzeugmaschinen durch optische Messgeraete."

Optical devices are increasingly being equipped with "zero adjustment," which permits placing the origin of a coordinate system on full-millimeter or zero-millimeter readings at the instrument. Computations formerly required for the displacement of the machine tables on boring mills and other machine tools are not necessary in the case of zero adjustments. Partial zero adjustment can be obtained by displacing the optical device in the direction of the axis of the scale or by displacing the graduated scale itself in this way. The best method, however, is an optical, not a mechanical, change. This can be obtained by rotating a prism in—or in front of—the optical instrument. Full zero adjustment requires displacement of the measuring scales to zero position or the use of graduated tape in conjunction with a centimeter scale.

Other parts of the article deal with the zero adjustment for measuring of angles, and the setting of the desired dimension in the instrument and readjusting to zero. It is claimed that this optical device reduces setup time considerably, particularly in the case of large machine tools such as horizontal boring mills.

Machining Aluminum

Whether or not built-up edges protect the tool face—a matter of dispute—built-up edges are detrimental to the surface finish of the workpiece. Writing on this subject in the Russian magazine, *Stanki i Instrument*, V. B. Livshits discusses the "Effect of Built-Up Edge on a Cutter on the Surface Quality of Aluminum Alloys." The article, translated into English in *Machines and Tooling*, Vol. 31, No. 11, 1960, p. 29-31, describes work performed at Tomsk Polytechnic Institute.

In the tests, it was found that the intensity of the formation of the built-up edge is reliably indicated by the cutting temperature. The maximum growth of the built-up edge and its disappearance correspond completely with the temperature intervals determined for each of the aluminum alloys investigated. Two of the alloys had high silicon content (9.7 percent), one had 7.1 percent magnesium, another had 5.59 percent copper and 5.12 percent silicon. These alloys are different from those commonly used in the United States.

The tests were run at cutting speeds ranging between 6.5 (?) and 2450 fpm and feeds between 0.0002 and 0.0010 ipr. Surface finishes were evaluated with respect to the microroughness in the direction of feed. The built-up edge was measured with a special instrument.

In order to insure a microroughness close to the theoretical value for a wide range of speeds, the author recommends making the feed smaller than the tool nose diameter multiplied by the sine of the side cutting edge angle.

Ideal cutting performance—cutting with no built-up edge—is obtained when using a recommended combination of feeds and speeds diagrammed in the article. The diagram shows that at recommended feeds and speeds the temperature varied between 500 and 600 F, depending on the type of alloy. The worst condition—and the largest built-up edges—existed when the temperatures were as low as 85 to 175 F. These values apply only to the particular test conditions, with an end cutting edge angle of 20 deg, cutting dry.

It was also found that the thermal conductivity of the aluminum alloy affects the formation of a built-up edge. The higher the thermal conductivity of the work material, the higher the cutting speed that can be attained without built-up edge.

An alloy designated Al-8, containing 7.1 percent magnesium and having a 72 Brinell hardness (sand cast) must be machined at low speeds to avoid built-up edge, while an alloy designated Al-4, containing 9.7 percent silicon and having a 55 Brinell hardness can be machined with a high speed-feed combination.

The author points out that the machining characteristics of various alloys should be taken into account in the design of aluminum parts.

Metalcutting Theory

Two papers on new developments in metalcutting theory were recently presented before the Institution of Mechanical Engineers at Leeds (England). Abstracts of these papers are published in *The Chartered Mechanical Engineer*, April 1961, p. 234-235. One of the pa-

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Tool Engineering in Europe

pers, by P.L.B. Oxley, A. G. Humphrey and A. Larizadeh, deals with new findings that may change conventional metal working concepts. The paper, "Influence of the Rate of Strain Hardening in Machining," covers their theory that the chip is formed by a combination of shear and bending, as opposed to the simple shear plane. The authors have found that the stress distribution along the boundary of the workpiece and the plastic zone varies from compression near the outer free surface to tension near the cutting edge. Although this is not an entirely new finding, it is important, when considered in the light of the much-disputed "gap" ahead of the cutting edge and also in the light of ultrahigh-speed machining phenomena encountered in American tests.

The second paper, "Metal Cutting and the Built-Up Edge," by W. B. Heginbotham and S. L. Gogia, describes four different types of built-up edges—positive wedge, negative wedge, rectangular wedge and layer type. The positive and negative types produce effective rake angles differing from the angle ground on the tool. Contrary to findings by other researchers, the authors have observed built-up edges at cutting speeds up to 450 fpm, even when ceramic tools are used. They were able to relate the size of the built-up edge to the feed and to the co-efficient of thermal diffusion.

Surface Finish Research

The relationship between the measuring force, the radius of the stylus and the deformation of standard and flat work surfaces during surface inspection has been studied by L. W. Nickols and T. R. J. Oakley. Their findings are published in *The Chartered Mechanical Engineer*, January 1961, p. 22-23, in an article with the title "The Influence of Measuring Force, Stylus Radius and Surface Finish on the Accuracy of Measurement of Workpieces by a Comparator."

During tests, the radii of the stylii were varied within a range of $\frac{1}{32}$ inch to $\frac{1}{8}$ inch. Forces were varied between 4 and 32 ounces. The following conclusions were reached: (1) The measuring force should be small, to minimize local deformation at the contacting surface of the stylus and work, and to prevent permanent indentation; (2) the spherical end of the stylus should be large.

Use of a small measuring force results in a small standard deviation, which makes it possible to obtain results from only a few tests without substantial deviation. The relationship between measuring force and local de-

formation follows Hertz's Law, despite appreciable plastic deformation.

The authors' conclusion that the spherical end of the stylus should be large raises the question of how closely such a stylus can follow the contour of the surface. However, the authors state that variations in measurements were affected more by the texture of the surface than by the radius of the stylus, within the limits of the radii considered.

Tool Engineering in Hungary

According to an article in *Periodica Polytechnica*, Vol. 4, No. 3, 1960, p. 277-299, extensive courses in tool engineering have been introduced in Hungary. The article, by K. Heberger of the Technical University of Budapest, is entitled "The Task of Assistant Professors at the Polytechnical University."

Heberger says that substantial parts of the new engineering education program have been copied from institutions in the Soviet Union, although methods used in the technical universities of Western Europe have also been taken into account. In England and the United States, incidentally, a different approach is followed. Only engineering fundamentals are taught, while advanced education—particularly in the field of tool engineering—is left up to industry.

The Budapest courses in tool engineering are flexible and their content is changed in the light of surveys of tool engineering journals from many countries. The proceedings of engineering conferences are analyzed to make sure that the content of the tool engineering courses reflects the latest findings and practices and reports on tool expositions are studied for the same reason.

Tool engineering is taught in postgraduate courses. The theory of metalcutting, as a fundamental subject, is taken up first. It is followed by work involving the machining of cylindrical and plane surfaces, boring, profiling, thread cutting, advanced lathe operation, turret lathe work, single-spindle automatic operation, milling, assembly, machining of nonmetallic materials, accident prevention and many other machining subjects. Practical tests such as stress investigations, deflection and vibration analyses, efficiency determinations and the like, are made on machine tools.

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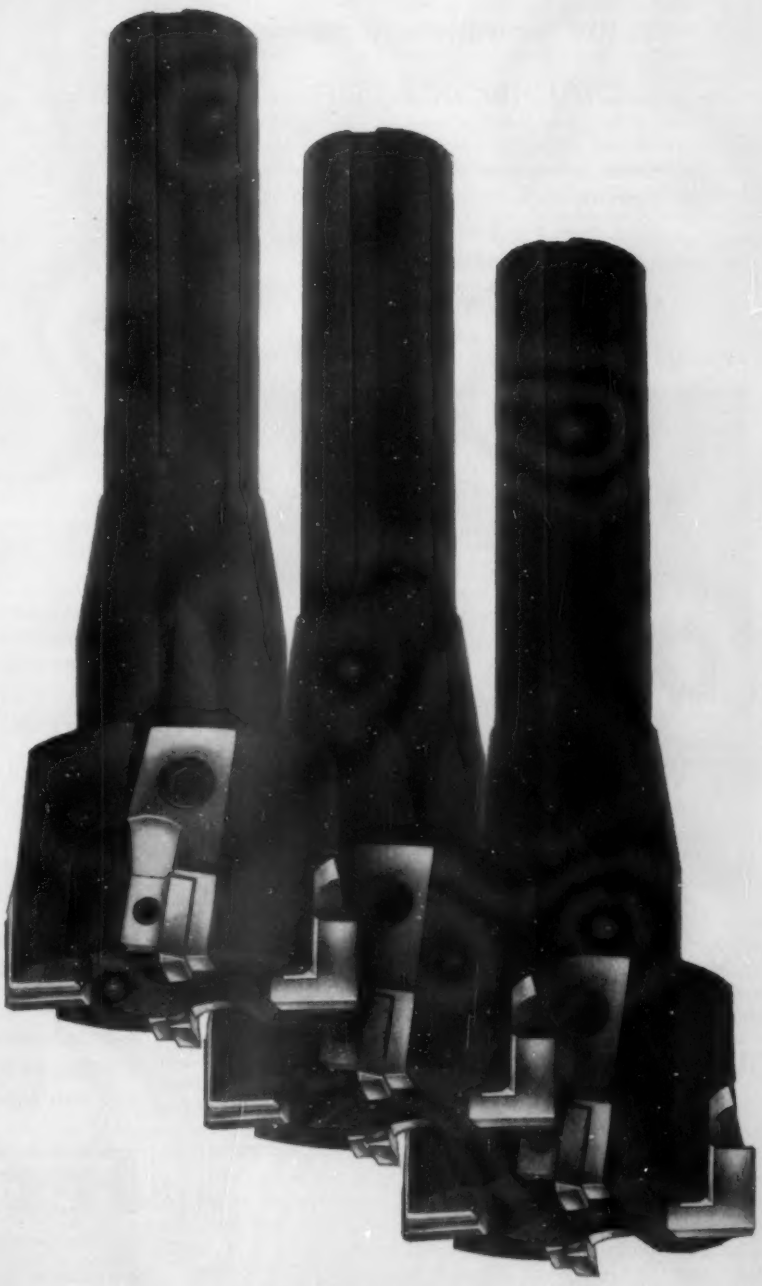

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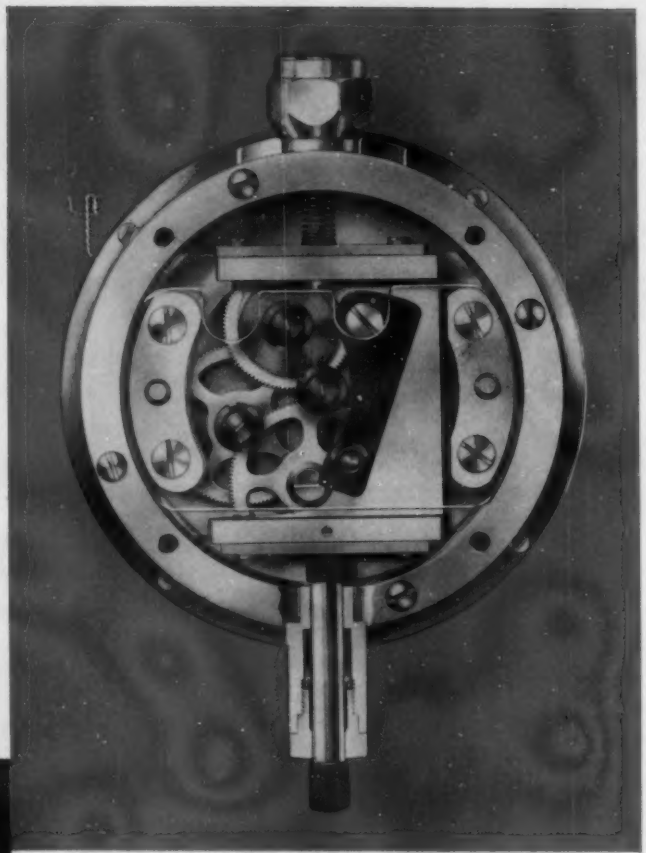

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INTRAFORM—A PROCESS in which hollow cylindrical stock is placed over the mandrel and squeezed by rapidly pulsating dies—forms profiles on the inside diameter of workpieces quickly and accurately without expensive tooling. Meta-Dynamics Div., Cincinnati Milling Machine Co. **(Circle 501)** . . . Special publications in the standardization field, pamphlets and standards recommendations of the International Organization for Standardization and the International Electrotechnical Commission are listed in the "1961 Catalog of American Standards." American Standards Assn. **(Circle 502)** . . . Recommended rates for 10 separate machining operations for 37 different types of stainless steel including the precipitation hardening grades are condensed on one easy-to-use, quick reference chart. Peter A. Frasse & Co., Inc. **(Circle 503)** . . . "Design ABC's of Rolled Worm Threads" fully illustrates and describes the general rules of design and practice. Landis Machine Co. **(Circle 504)** . . . "The Concept of the Basic Machine" is the first of eight articles to cover dial type machines and tooling applications on these machines. Bodine Corp. **(Circle 505)**

Automation, Mechanization

Hinged steel belt conveyors are suitable for portable or for permanent installations. May-Fran Mfg. Co. **(Circle 506)** . . . Available in two models, a gear and rack type press unloader is engineered to catch workpieces which are ejected from the die, at or near the top of the press stroke. The positive knockout of the press ejects the workpiece onto the extended tray and the tray and part are then automatically ejected as the press ram descends. Livernois Engrg. Co. **(Circle 507)** . . . An automatic programming aid for the 400 electronic data processing system is designed to simplify the programming task by eliminating the need for the programmer to be completely familiar with the machine language. Minneapolis Honeywell Co. **(Circle 508)**

Boring, Drilling, Tapping

In addition to a tap selection system that uses a color-coding method, the "Besley Color-Keyed Tap Selector" booklet includes information about tap functions, sizes, styles and standards. A trouble-shooting chart describes the cutting characteristics of various metals, makes tap recommendations and lubrication suggestions and discusses tapping problems along with their possible solutions. Besley-Welles Corp. **(Circle 509)** . . . A turret drilling machine bulletin includes complete descriptions and lists specifications for 10 tape-controlled systems, together with four pages of case histories of actual installations. Burgmaster Corp. **(Circle 510)**

Casting, Molding

"Combining Ceramic and Investment Molding in a Single Casting" describes how the two molding techniques are combined to take advantage of the comparatively low tooling and pattern costs of ceramic molding and the added dimensional and tolerance control of the lost wax method. Lebanon Steel Foundry. **(Circle 511)** . . . An 8-page brochure comprehensively covers the centrifugal casting process. Centrifugal Casting Co. **(Circle 512)** . . . The revised second edition of "How to Design Precision Investment Castings" discusses in detail many basic design principles as they apply to the lost wax investment casting processes. Midwest Precision Casting Co. **(Circle 513)**

Cleaning, Painting, Plating

"Specialized Chemical Processing Compounds for the Metalworking Industry" contains specific information for the use of 43 products in a line of cleaning and processing compounds. Among the processes discussed are cleaning, phosphating, conversion coatings, protective coatings, paint and carbon removing, descaling, rust removing and prevention, inspection and processing aluminum. Turco Products, Inc. **(Circle 514)** . . . "Keeps Parts Rust Free" describes a metal protective coating for indoor rust prevention. The coating is for tools, dies, guns, freshly machined parts, raw stock or work in process and idle or stored machinery. White & Bagley Co. **(Circle 515)** . . . The Dalic Process—a method of electroplating localized areas of a workpiece quickly without using immersion tanks—is as much as 60 times faster than bath-plating methods. It permits application of metallurgically sound, very fine-grained deposits of 19 different platable metals, plus numerous alloys, upon selected areas of a workpiece. Sifco Metachemical, Inc. **(Circle 516)** . . . "How To Save Money and Cut Downtime with Metallizing" presents nine separate stories of cases where products were salvaged or improved with modern metallizing. Metco, Inc. **(Circle 517)**

Cutting Tools, Holders

Complete information on toolholders, setup and hold-down tools, toolbits, wrenches, miscellaneous hand tools and pipe tools is given and illustrated in a 132-page catalog. Armstrong Bros. Tool Co. **(Circle 518)** . . . Included in a bulletin describing a new series of toolbits is information on tool grinding. Morse Twist Drill & Machine Co. **(Circle 519)** . . . Full-floating toolholders grip reamers firmly, yet compensate for both parallel and angular misalignment. Flanged adjustable holders provide parallel correction only and are locked in place with no float. Erickson Tool Co. **(Circle 520)**

Fastening, Joining

Showing how to take the guesswork out of bolted assemblies, assure maximum clamping force from threaded fasteners and eliminate bolt failures caused by substandard tightening is the purpose of a folder. The folder also outlines the importance of accurate torque-tension relationships to fastener efficiency and explains why torque, in itself, is not a reliable measure of fastener holding power. Skidmore-Wilhelm Mfg. Co. **(Circle 521)**

Finishing, Grinding

Emphasis of a report on pressure blasting with manufactured abrasives is on the proper selection and use of aluminum oxide and silicon carbide abrasives. Norton Co. **(Circle 522)** . . . A series of booklets cover the history and the physical and chemical properties of abrasive materials and discuss the

purpose of abrasive grain in various operations, the factors influencing its use, the types of abrasive grain used and the reasons for their use and the methods of application. Abrasive Grain Assn. **(Circle 523)** . . . To help eliminate chatter and chip clogging and to provide effective cutting power over the entire surface, Bi-Dex files have a type of fluting that combines the advantages of both sectional and center fluting. Facet Tooth files—another member of a line of tungsten carbide rotary files—have a second helicoidal edge added to the full length of each tooth which strengthens the flutes and allows more efficient rake and lip angles. Grobet File Co. of America, Inc. **(Circle 524)**

Electric Motors, Controls, Drives

Many uses of remote indicating load cell systems throughout industry are illustrated in a manual which also suggests imaginative ideas for new applications not commonly known. W. C. Dillon & Co., Inc. **(Circle 525)** . . . Industrial limit switches—built specifically to meet the problems encountered in the control and construction of machine tools and other heavy machinery—have completely isolated circuits, double break contacts with wide contact gaps, liberal over-travel, precise repeatability and NEMA 12 housings. R. B. Denison Mfg. Co. **(Circle 526)** . . . Complete specifications and details on low pressure switches and velocity-actuated flow switches for the electronic, machine and processing industries are described in a 30-page catalog. Henry G. Dietz Co., Inc. **(Circle 527)**

Fluid Power

Ninety-six basic models of a miniaturized pump are fully described and illustrated in a catalog covering every requirement for a complete hydraulics installation, from pumps to accessories. Oil-Dyne, Inc. **(Circle 528)** . . . Explosion-proof and variable speed air motors in sizes from 1/20 to 7 hp; air compressors in sizes from 0.6 to 45 cfm, up to 30 psi, and vacuum pumps in sizes from 0. to 50 cfm, up to 28 inches Hg are described in a catalog. Gast Mfg. Co. **(Circle 531)**

Heat-Treating

Technical bulletin describes a new Hyex inert atmosphere generator available in ten different cfh ratings from 500 to 25,000. Lindberg Engrg. Co. **(Circle 529)** . . . Text explaining how to prepare an economic study on heat processing furnaces includes sections on where to obtain data and how to make the study; a table showing items in the studies; and three typical examples. General Electric Co. **(Circle 530)** . . . Gas-fired infrared burners—designed for low-temperature commercial and industrial process heating—can handle applications such as clay and ceramic drying; chemical processing; paint or paper ink drying; die and mold heating; drying, curing and setting plastics; and metal finishing. Eclipse Fuel Engrg. Co. **(Circle 531)**

Inspection, Measurement

Pore evaluations of plastics, sintered metals, ceramics and structural materials are possible using an instrument based on the mercury-intrusion principle whereby samples are immersed in mercury and subjected to varying degrees of pressure. American Instrument Co., Inc. **(Circle 532)** . . . The text of an 11-page catalog discusses a metallograph research instrument providing effective results with bright field, dark field and polarized light for both visual observation and photomicography. Bausch & Lomb Inc. **(Circle 533)** . . . A 480-page catalog displays more than 3500 items, including hand measuring instruments, dial indicators, dial gages and instruments, and saws. L. S. Star-

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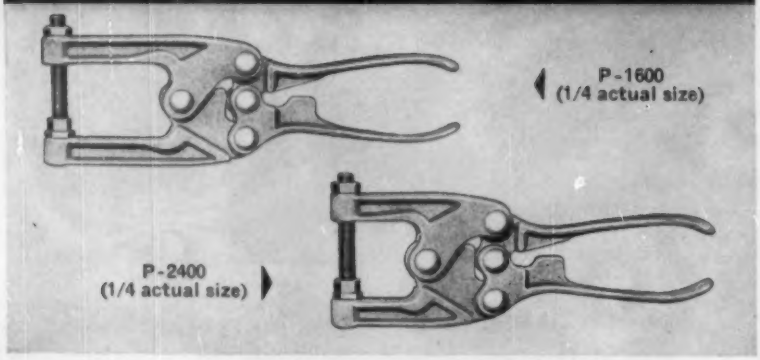
***KNU-VISE* TOGGLE PLIERS with**
1600 & 2400 lbs. clamping force



In keeping with its reputation for providing the industry's most efficient toggle clamps and pliers, Lapeer Manufacturing Company has introduced new plier models—the P-1600 and P-2400 series.

Long and comfortable handles are a feature of these Lapeer Knu-Vise pliers. With average handload, these pliers provide a clamping force of 1600 and 2400 lbs. respectively. The P-1600 series has a throat depth of 2¼", and throat gaps of 1 3/16, 3, 4 and 6 inches. The P-2400 series has a throat of 1¼" x 1¼". Each series is available with two opposing spindles. All models can be furnished with unlocking levers. The pliers are made from steel forgings, heat-treated, and cadmium plated.

Write for more information and remember—LAPEER KNU-VISE GIVES YOU MORE VALUE FOR YOUR MONEY.

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rett Co. **(Circle 534)** . . . Two new dial indicators—one balanced and the other continuous—have an accuracy of ±0.0005 inch for the 0.015 total range of two and half turns. L. S. Starrett Co. **(Circle 535)** . . . After measuring the distance between holes and surfaces in two dimensions to an accuracy of better than 0.001 inch, a coordinate measuring machine flashes the answers out on two illuminated digital readout panels. Sheffield Corp. **(Circle 536)** . . . Booklet entitled "Temperature Recording from Platinum Resistance Sensors" describes and illustrates how an amplifier and a platinum resistance sensor are applied to provide a combination for recording temperatures—registering deviations of 0.01 deg—from 320 to 2000 deg. Brush Instruments. **(Circle 537)** . . . Battery-operated and portable, a vibration meter with high gain, transistorized circuitry reads amplitudes of both absolute and relative vibration directly on its meter dial. Korfund Co., Inc. **(Circle 538)** . . . "Automatic X-ray Spectrograph Speeds Analyzing of Metals" is a reprint of an article discussing the analysis of electric arc furnace charges in minutes as compared to former methods which provided answers days after castings were completed. Philips Electronic Instruments. **(Circle 539)**

Materials

Over 100 specific equipment parts that gain increased wear protection from hardfacing are listed in a section together with the type of wear which each is most subject to and the alloy needed to protect it. Air Reduction Sales Co. **(Circle 540)** . . . "Bibliography on Cobalt-Nickel Coatings" contains 135 references to world-wide literature from 1899 to 1961 with abstracts accompanying those references from 1956 to 1961. Cobalt Information Center. **(Circle 541)** . . . "Bibliography on Cobalt-Nickel Alloy Properties lists 155 references from 1927 to 1961 and includes abstracts from 1955 to the present. Cobalt Information Center. **(Circle 542)** . . . Over 100 highly corrosive media in concentration up to 100 percent and temperatures up to 400 deg are presented in graphic form by "The Corrosion Resistance of Zirconium" booklet. Zirconium Assn. **(Circle 543)** . . . Two technical bulletins guide users of a new system for creating laminated tools that retain strength in continuous operation at high temperatures. Smooth-On Mfg. Co. **(Circle 544)** . . . Twenty models of a pump for proportioning, mixing, and dispensing two and three part multicomponent resin systems in metered shots or continuous flow—low or high viscosity ranges—are described in a booklet. H. V. Hardman Co., Inc. **(Circle 545)** . . . A pamphlet describes a complete line of aluminum tooling plates designed to meet all machining specifications. Aluminum Co. of America. **(Circle 546)**

Welding, Soldering, Brazing

"New Techniques for Cladding with the Gas-Shielded Process," by Ralph D. Engel, provides background information on the development of a method of overlaying dissimilar materials. This process is presently used in the cladding of nuclear reactor shells. Air Reduction Sales Co. **(Circle 547)** . . . Dip brazing—the aluminum fabrication technique designed for aerospace, electronic and commercial components—is the subject of an 8-page illustrated technical brochure. Precision Dipbraze, Inc. **(Circle 548)**

Workholders, Fixtures

Feature of a fixture for sharpening end mills and milling cutters is a spindle that floats on 0.0001 inch of air, providing sensitivity to finger control and freedom of action in any direction. Harig Mfg. Corp. **(Circle 549)**

PUSH BUTTON *Speed Selection*

from **to** **in seconds**

or to *any* intermediate speed, *instantly*

Just push a button and watch the large tachometer dial on the headstock!

It's that easy!

The work is done by a motor driven speed changer. It accelerates or slows the lathe to any desired speed in seconds. With a 10:1 ratio, this new variable drive makes it easy to select from a wide range of speeds—200 to 2000 rpm in direct drive and 40 to 300 rpm in back gear.

Maximum stability and smooth power transmission are assured because the drive unit is oversized. All pulleys and shafts are fully supported (eight bearings). Double V-belts throughout the drive eliminate slippage and deliver full power to the spindle. Because of this rigidity and extra pulling power, this lathe will take heavy cuts at all speeds and precision finish cuts at high speeds.

It is a precision lathe, moderate in price, with the versatility for toolroom, production or second operation jobs.

SHELDON *Variable Speed* **PRECISION LATHES**

Illustrated WM54P 13" Swing- 34" Centers

Write for

"Variable Speed" Circular and General Catalog showing . . .

- 10", 11", 13" and 15" SHELDON Precision Lathes (Bench, Pedestal and Cabinet types)
- 13" and 15" SEBASTIAN Geared Head Lathes
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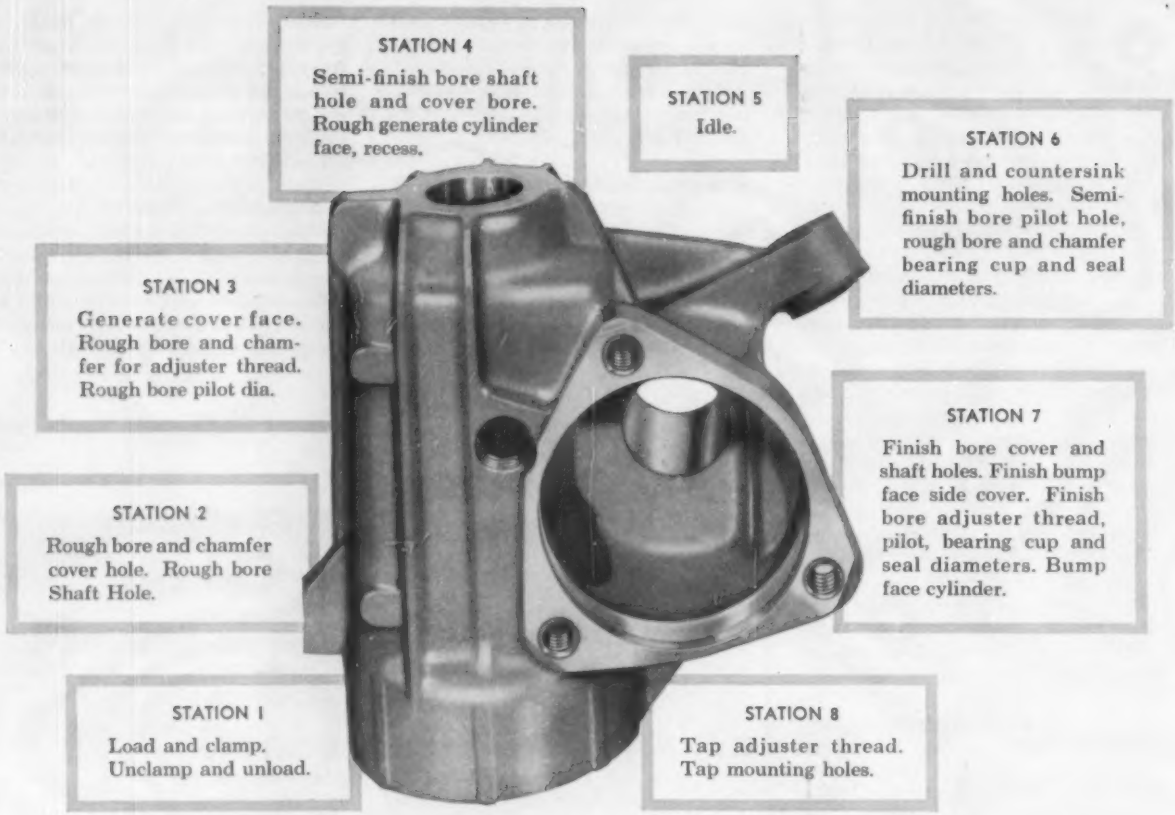
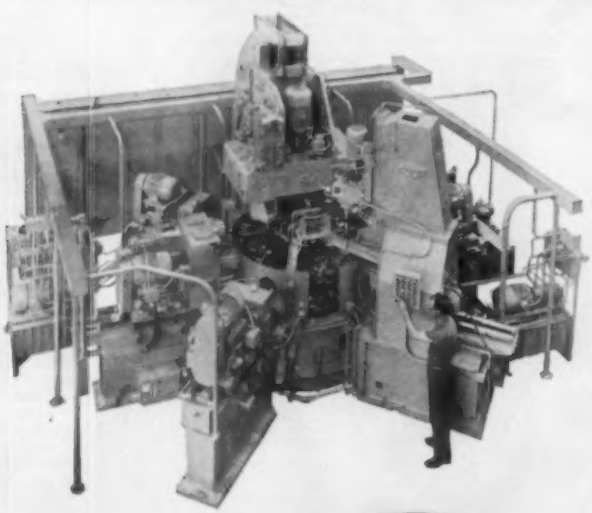

STATION 4
Semi-finish bore shaft hole and cover bore. Rough generate cylinder face, recess.
STATION 5
Idle.
STATION 6
Drill and countersink mounting holes. Semi-finish bore pilot hole, rough bore and chamfer bearing cup and seal diameters.
STATION 3
Generate cover face. Rough bore and chamfer for adjuster thread. Rough bore pilot dia.
STATION 7
Finish bore cover and shaft holes. Finish bump face side cover. Finish bore adjuster thread, pilot, bearing cup and seal diameters. Bump face cylinder.
STATION 2
Rough bore and chamfer cover hole. Rough bore Shaft Hole.
STATION 1
Load and clamp. Unclamp and unload.
STATION 8
Tap adjuster thread. Tap mounting holes.

153 Aluminum Steering Gear Housings per hour

automatically processed on this GREENLEE Machine



This Greenlee 8-Station Horizontal and Vertical Spindle Machine is establishing some excellent performance records for a leading automotive manufacturer. The 52 inch table carries 8 work fixtures. Each has power clamping. To insure rigidity and accuracy, the table is clamped hydraulically metal to metal. Indexing is fully automatic. Cycle time is 23.5 seconds. Like all Greenlee machines it's built for long, continuous service. Can be modified economically if desired. Have our representative give you complete information.

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Men at Work

John W. Walborn

Walter I. Krewson, Jr.

JOHN P. CARPENTER has joined the Bert Carpenter Co. as general manager. Carpenter's background includes 25 years in machine tool manufacturing and sales.

OTTO H. EIFFERT, former president and general manager of Sargent-Greenleaf, Inc., in Rochester, N. Y., recently arrived in the United States after spending the past two years as industrial management advisor at the U. S. International Cooperation Administration mission in Seoul, Korea. During his assignment in Korea, Eiffert provided technical assistance to fifty Korean manufacturing plants producing a variety of products ranging from diesel engine fuel injectors to sewing machines. He also worked as a laboratory advisor to the Central Industrial Research Institute.

Heald Machine Co., Worcester, Mass., has announced that the company will be organized into two main divisions—the Grinding Machine Div. and the Bore-Matic Machine Div. A. FRANCIS TOWNSEND, formerly vice president of engineering, has been named vice president and manager of the Grinding Machine Div., while ALBERT A. ARBOGAST, formerly branch manager of the company's Detroit, Mich., sales office, has been made manager of the Bore-Matic Machine Div. Townsend, with Heald for 26 years, has been a vice president since 1953. Arbogast, a 27-year veteran, has been in Detroit for five years and previously was branch manager of the company's Indianapolis, Ind., office.

The election of FRANK R. MILLIKEN (pictured) as president of Kennecott Copper Corp., New York, N. Y., has been announced. Milliken succeeds CHARLES R. COX, president since January 1950. Cox will continue as a director and member of the executive committee. Milliken served as vice president in charge of the company's mining operations since joining Kennecott in 1952, and assumed the position of executive vice president and membership on the board of directors in May 1958.

Dorr-Oliver Inc., Stamford, Conn., has announced the appointment of JOHN W. WALBORN (pictured) as plant manager of the Hazleton, Pa., plant. Walborn came to Dorr-Oliver on Feb. 15 from Farris Engineering Corp., Palisades Park, N. J. He has had over 25 years of production and plant management experience.

Election of DAVID H. BAKER by the board of directors of Vickers, Inc., Detroit, Mich., as a vice president and general manager of its international division has been announced. Baker, president of Capital Airlines, Inc., since 1957, succeeds R. E. Esch. Esch, formerly vice president and general manager, will remain with the company as vice president and consultant.

DR. NICHOLAS A. BEGOVICH has been appointed a vice president of Hughes Aircraft Co. Dr. Begovich, assistant manager of the company's ground systems groups in Fullerton, Calif., and director of product line operations there, conceived the idea of radar scanning by electronic means rather than mechanical. He joined Hughes as a research physicist in 1948 after receiving his doctor's degree from the California Institute of Technology.

Standard Tool & Mfg. Co., Lyndhurst, N. J., has recently announced the promotion of L. K. SHEPARD (pictured) to vice president of sales. Shepard has been with the company since 1958. After graduation from Purdue University, he was an experimental test engineer for Pratt & Whitney Aircraft Corp. in Hartford. Following the war, he went to Delta Manufacturing as development engineer.

Western Design & Electronics Div., U. S. Industries, Inc., New York, N. Y., has announced that GABRIEL C. DANCH (pictured) has been named vice president in charge of operations at Silver Spring, Md. Danch, previously man-

L. K. Shepard

Frank R. Milliken

Fred W. Beitner

Gabriel C. Danch

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- Drill most materials—aluminum, cast iron, brass, tool steel, stainless, etc.
- Drill any shaped part to any depth (sometimes interrupted holes or across existing holes),
- Drill shallow or deep holes to precision tolerances.

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Men at Work

ager of the Washington office of U. S. Industries, had also been with Ryan Aeronautical Co.

Appointment of WALTER I. KREWSON, JR. (pictured), as president of Superior Pneumatic & Mfg., Inc., has been announced. KENNETH LANG was named vice president and director of sales. Krewson came to Superior in 1956 from F. C. Russell Co., where he was purchasing agent.

RICHARD A. HARTMAN has been appointed vice president and product manager of Palnut Co., a division of United-Carr Fastener Corp., Mountainside, N. J. Hartman joined the firm in 1956, having held various sales and engineering positions in the fastener industry. As vice president and product manager, he will be responsible for product improvement and the development and promotion of new fasteners.

Robert L. Curtis

Advancement of ROBERT L. CURTIS (pictured) to the position of sales manager of all T-J products has been announced by Tomkins-Johnson Co., Jackson, Mich. Curtis joined the firm in 1950 and served most recently as technical service manager and advertising manager.

FRED W. BEITNER (pictured) has been appointed vice president of sales for Trent Tube Co., of East Troy, Wis., a wholly owned subsidiary of Crucible Steel Co. Beitner, who joined Trent's sales department in 1946, has been a sales engineer, district sales manager and general sales manager.

The appointment of WILLIAM P. BALTHROP as president of Chrysler Corp.'s Airtemp Div. has been announced. Balthrop succeeds P. M. Augenstein who has resigned. Balthrop joined Chrysler in 1944 as a graduate student engineer. For the past year he has been president of the Amplex Div., a part of the corporation's special products group.

B. K. Crawford, president of Standard Tool & Mfg. Co., Lyndhurst, N. J., announced the promotion of STEPHEN C. TIENSCH to vice president of manufacturing. Before joining Standard, Tiensch worked with American Can Co.

LOUIS M. HAGUE (pictured) was elected chairman of the board and chief executive officer of Hanson-Van Winkle-Munning Co., Matawan, N. J., and WARREN S. WILKINSON (pictured) was elected president. Hague, formerly a vice president of the company, joined Hanson-Van Winkle-Munning in 1928 and, in 1948, was elected president. Wilkinson joined the company in 1946 as plant manager. Appointed assistant to the president in 1956, he has been executive vice president since 1958.

Louis M. Hague

Warren S. Wilkinson

STEPHEN SANDERS has been appointed vice president in charge of sales by Rolled Steel Corp., Skokie, Ill. In his new position, Sanders will supervise company sales with the exception of the export division. Prior to his appointment, Sanders was a regional sales manager.

At the board of directors meeting following their annual meeting, Jones & Lamson Machine Co., Springfield, Vt., elected ROBERT S. JONES as vice president and general manager. Jones started with Jones & Lamson in 1940 as a machine operator. He held successive positions as foreman, manager of subcontracting, general foreman, assistant to

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the superintendent, factory manager, manager of manufacturing, general manager of the products division and general manager.

Cone Automatic Machine Co., Inc., Windsor, Vt., has announced the appointments of J. ARNOLD KIELY as executive vice president and ROBERT R. RHODEHAMEL as vice president in charge of manufacturing.

P. S. Dickey, president of Bailey Meter Co., Cleveland, Ohio, announced three executive promotions. H. H. CORRIE has been elected executive vice president; L. F. RICHARDSON, vice president in charge of sales activities and a member of the board of directors; and J. H. DENNIS, vice president in charge of manufacturing. Corrie joined Bailey as a cadet engineer in 1927. He was named chief engineer in 1953, a vice president in 1955 and a director in 1957. Richardson became associated with the company in 1930. He was appointed sales manager of district operations in 1957. Dennis joined Bailey in 1937. In 1954 he was appointed manager of industrial relations and, in 1960, named manager of manufacturing.

EUGENE W. FULLER, executive vice president, Illinois Tool Works, was elected a director at the company's recent annual meeting. Associated with the Chicago, Ill., firm since 1928, Fuller has served in various administrative and executive capacities. He was formerly sales manager and later general manager of the company's Shakeproof Div., in Elgin, Ill. Fuller was elected a vice president in 1950 and executive vice president in 1959.

During the annual stockholders' meeting of Crucible Steel Co., Pittsburgh, Pa., GEORGE S. CRAFT was elected to the board of directors. Craft is president of the Trust Co. of Georgia and a director of the Federal Reserve Bank of Atlanta.

Colorado Fuel and Iron Corp., Denver, Colo., has elected LEONARD C. ROSE as executive vice president and RUDOLPH SMITH as executive vice president of operations. Rose has served as director of purchases for the corporation since 1947. Prior to joining Colorado Fuel in 1928, he had been associated with Ford Motor Co. and Algoma Steel Corp. Smith has been works manager for the Pueblo, Colo., plant since 1951. He has served in various positions since joining the company in 1927.

KEITH T. MIDDLETON was elected president of Fafnir Bearing Co., of New Britain, Conn., at the annual directors meeting. He succeeds Clarence G. Rosensweig who was elevated to vice chairman of the board. Middleton, formerly executive vice president and secretary, becomes chief operating officer and the company's sixth president.

SAMUEL C. CLARKE, manager of sales, Chambersburg Engineering Co., Chambersburg, Pa., has been named to the board of directors of the company. He succeeds Harrie B. Price, Jr., who has retired after 30 years as a director.

Hancock Telecontrol Corp. has named WILLIAM E. BACON administrative assistant to the president. Bacon had been supervisor of manufacturing engineering for Cleveland Welds plant of General Electric Co. since 1957. Joining G. E. in 1951, he held positions responsible for engineering, technical recruitment, project planning and general administration. In his new position with the Jackson, Mich., firm, Bacon will act as office manager and administrator.

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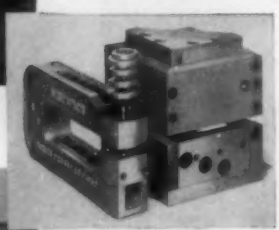
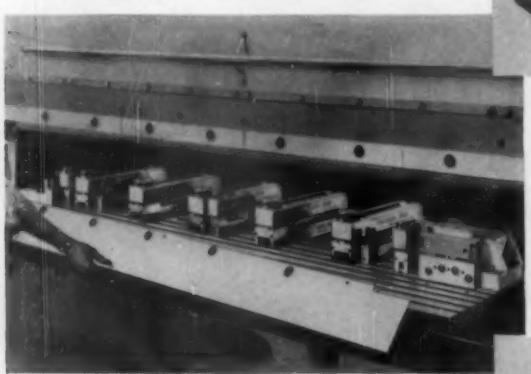


Set-up of Unipunch series "A" Hole Punching and Notching Units on a template. Series "A" Units punch and notch up to ¼" thick mild steel.



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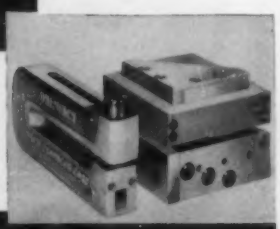

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ENGINEERING BOOKSHELF

INDUCTION HEATING, COIL AND SYSTEM DESIGN—*By P. G. Simpson. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price $11.50. 295 pages.*

Practical procedures for designing coils, power systems and generating equipment for service in induction heating applications are discussed. Coil and system designs are provided for typical applications in these fields. Also included are theoretical and practical design data such as graphs, tables, nomograms and illustrations, all of which are based on proven results.

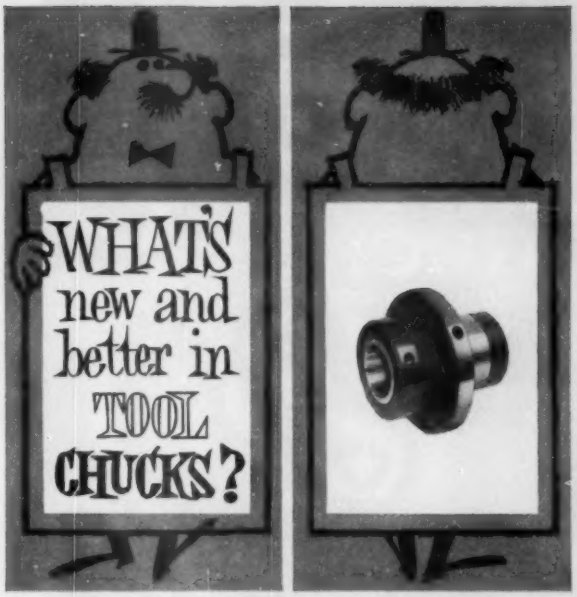
THE MACHINING OF STEEL—*By F. C. Lea and Eric N. Simons. Published by The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price $5. 208 pages.*

Fundamental machining practice excluding grinding is treated in this book. In addition to the techniques used in machining, the various types of commonly used machine tools are discussed in detail. Written for students, machinists and others interested in engineering production, *The Machining of Steel* makes few attempts to discuss machining theory or the more abstract problems related to this subject.

DYNAMIC ANALYSIS OF MACHINES—*By Joseph E. Shigley. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. Price $7.50. 645 pages.*

Static and dynamic forces in machinery are analyzed by means of the unit vector approach in this book. Also discussed are the digital computer, the electronic analyzer and the techniques required to use them in solving problems of dynamics. Mechanical transients are treated in two ways—by the graphical phase plane and by the analytical method. The final two chapters of the book discuss the highly important topics of cam dynamics and the dynamics of feedback control.

Correction: The price of *Theory of Metalcutting*, reviewed in the May issue is $7.50—not $17.50 as published. The editors regret any inconvenience this error may have caused author Paul H. Black, the McGraw-Hill Book Co., Inc. and readers of THE TOOL AND MANUFACTURING ENGINEER.



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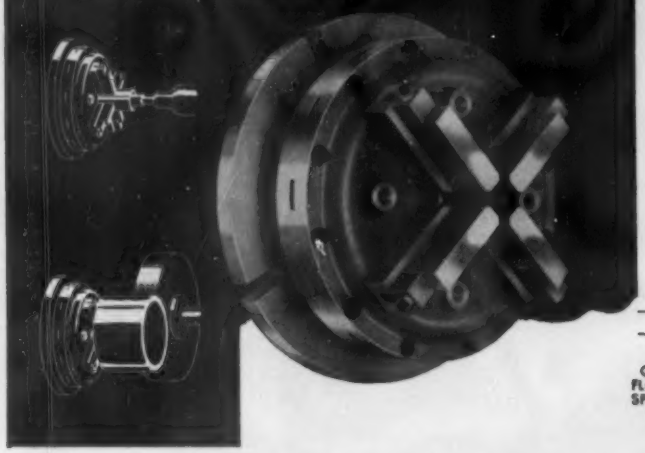

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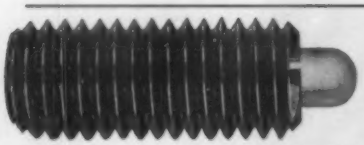

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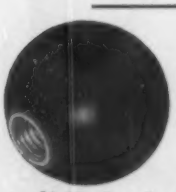

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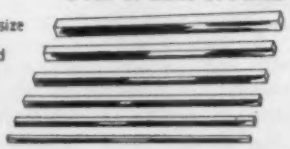

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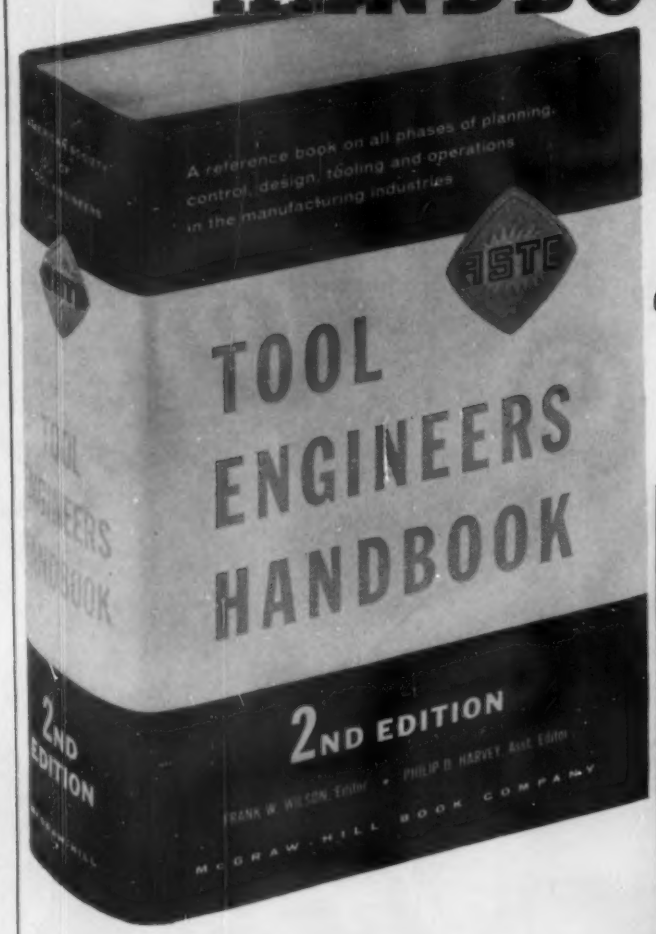
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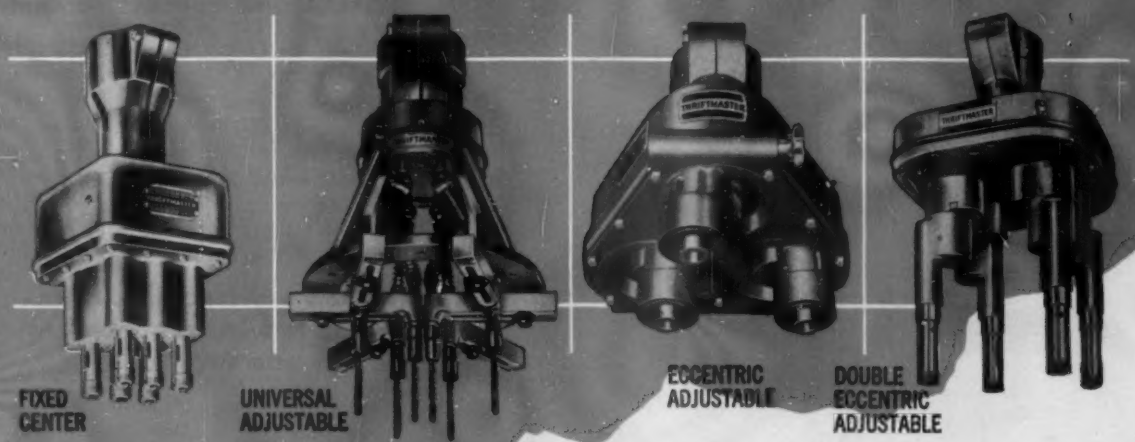

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Tool Steel Topics

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These photographs, taken at Mardigian Corporation, Warren, Mich., show the use of Bethlehem carbon water-hardening tool steel in trim dies for automobile front fenders. The dies, hardened to Rockwell C 62-64, trim 20-gage cold-rolled sheet steel. In the picture above, 15 sections of the tool steel, bolted into the casting, are ready for "Kellering." The companion picture was taken after the tool steel sections were machined to contour and heat-treated, making a completed form-and-trim die.

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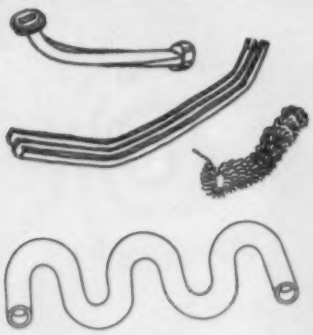

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2. SEMI-AUTOMATIC MAGAZINE LOADING
3. FULLY AUTOMATIC HOPPER LOADING

FEATURES:

- Infinitely variable hydraulic feeds
- Automatic box type hob cycle...no hob approach
- High spindle speeds...4800 rpm maximum
- High production rates
- AGMA Class III precision accuracies possible
- Centralized lubrication
- Automatic part deburring
- Low cost tooling
- Simplicity of set-up and quick change-over

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strength that creates new tooling concepts

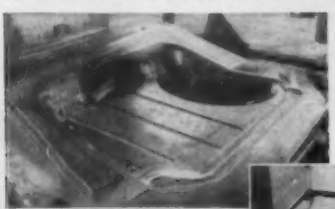
ren®

PLASTIC TOOLING MATERIALS

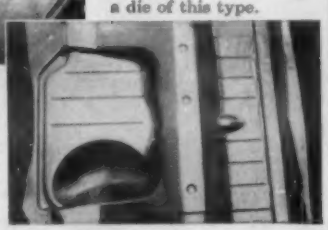
Not all tooling requires the inherent strength of REN epoxy resins. Often these rugged plastics save in construction time, in man-hours and in adaptability, (for easier, faster design changes). Rugged strength is there, too! It allows you to think more creatively than ever before — it encourages design requiring high compressive strength, even to medium production runs. When you think of plastics — think of REN for the finest in epoxy resin compounds.

Send for your free subscription to REN's bi-monthly publication, Tech-Ni-Tips/Tooling Digest.

COMPLEX PLASTIC DIE DRAWS 18,000 PARTS



An epoxy-faced die used in drawing floor pans at Checker Motors Corporation, Kalamazoo, Mich. As many as 18,000 parts have been drawn using a die of this type.



Floor pan drawn by epoxy faced die (above). Checker has drawn up to 10 major body panels using epoxy dies.

OFFICES AND WAREHOUSES IN PRINCIPAL CITIES.
Write Dept. 60-S

ren *plastics, inc.*
lansing 9, michigan

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DRILLUNIT *Solves* Drilling Problems

Flexible-Dependable

Self contained —Compact,—can be mounted in any position or angle, in a small area.

Single or Multiple spindle applications, can be adapted for Drilling, Reaming, Chamfering, Boring, Counter Boring and Spot Facing.

Stroke and feed variations obtainable without changes in the unit.—Step feed drilling possible with slight modification.

9" and 12" stroke —up to 5 H.P.

Standard Models Available from Stock

Write for literature.

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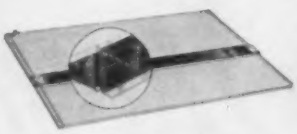
MAYLINE



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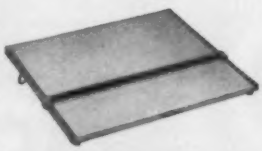
Choose Mayline Drafting Equipment

With Mayline drafting furniture and equipment you get quality workmanship and materials, high performance, durability, and pleasing appearance. All products discussed in Catalog 11. Write for your copy today.



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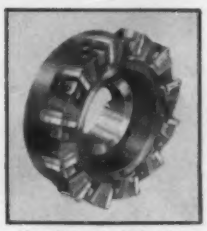
YOUR ONE SOURCE SUPPLIER



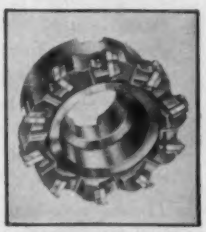
Negative rake indexable insert milling cutters

Staggered tooth inserted blade HSS milling cutters

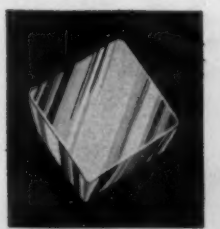
Throwaway-insert boring bars

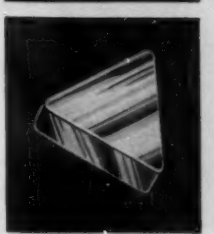
Half side inserted blade milling cutters

Clamp-type throwaway-insert tool holders



Positive rake indexable insert milling cutters





All sizes and types of throwaway-inserts: HSS; cast alloy; carbide; ceramic. Send prints for quotations on Negative and Positive rake inserts.

ONE FOR ALL ... ALL FROM ONE

The wise way to buy Carbide, High Speed Steel, Cast Alloy and Ceramic Throwaway-Inserts, and Tool Holders, Milling Cutters, and Boring Bars is to buy from one knowledgeable source. Viking tool engineers know the applications of not merely one of these items, but of *all* of them as they so vitally relate to each other in order to obtain maximum cutting performance with minimum loss in time and materials. Because Viking engineers are *pioneers in the throwaway-insert and tool industry*, they are uniquely able to recommend the right tool and/or insert for your particular need. They are at your service.

ASK FOR AN INTRODUCTION

Viking TOOL CO.

45 Nichols Road, Shelton, Connecticut

why Servo uses NIKON OPTICAL COMPARATORS

SERVOTHERM® infrared detectors are thermister bolometers manufactured by Servo Corporation of America for military and industrial use.

The sensitive nerve cell of a thermister bolometer consists of two semi-conductor elements with high negative temperature coefficients. These elements are appropriately called 'flakes', for each is hardly more than 1/250th of a square inch in area, and only .0004 inch thick.

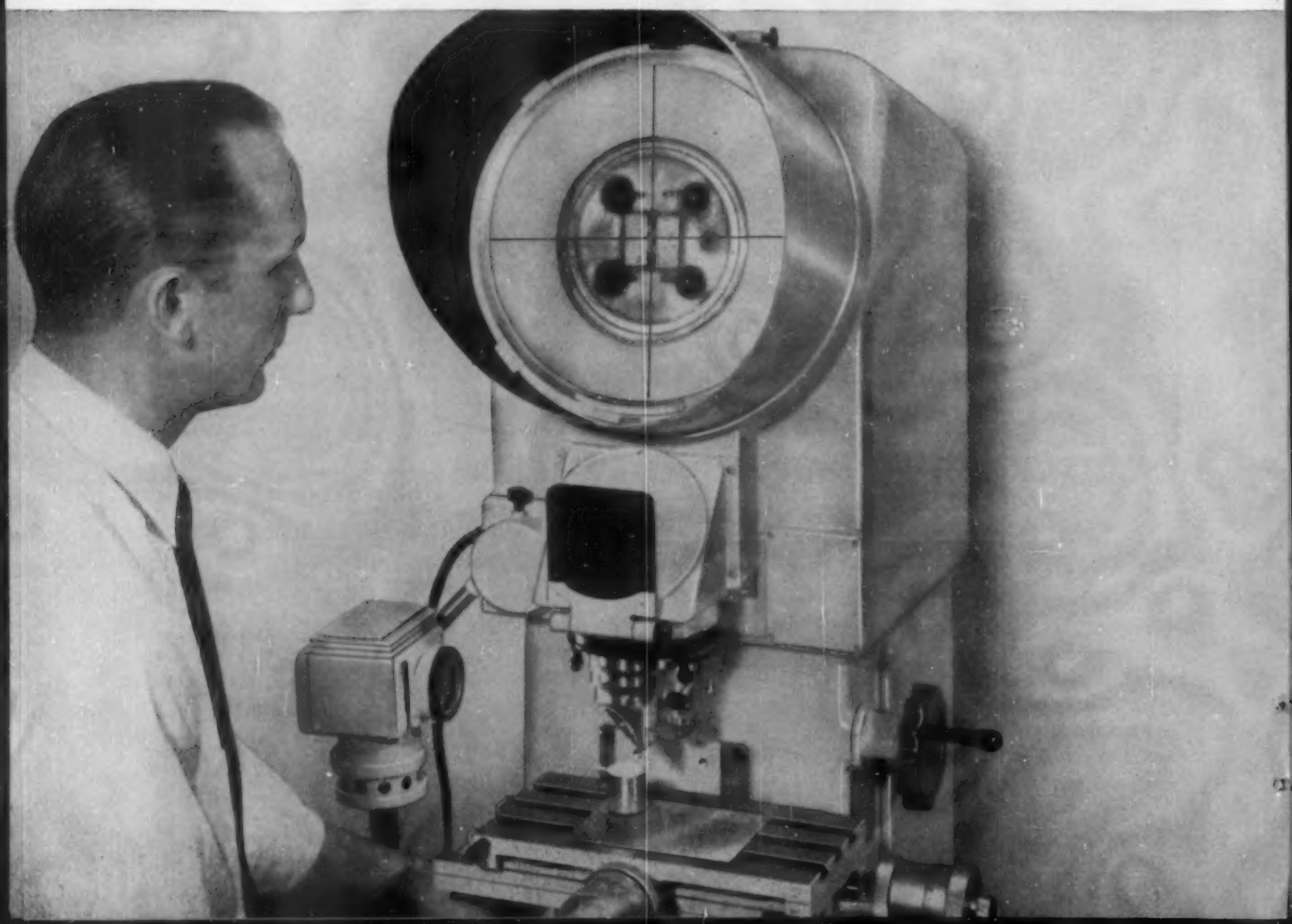
These 'flakes' must be flawless, and must pass rigid inspection for critical dimensions, positioning in the cell, solder junctions, and for possible defects. They are so fragile that no ordinary mechanical inspection means can be used.

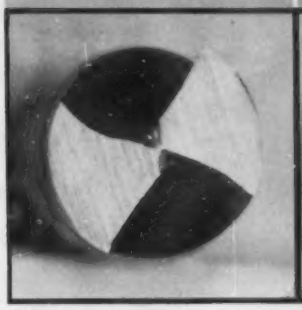
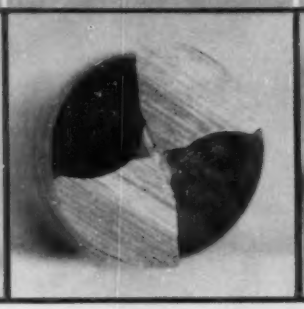
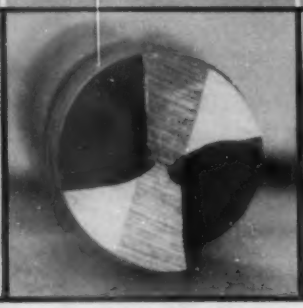
Servo Corporation has solved this inspection problem by using a Nikon Model 3 Optical Comparator. A sharp, bright, highly magnified image of the 'flake' appears on the comparator screen where it is conveniently, quickly and accurately inspected, and precise measurements made to within .0001 inch. No tool touches the 'flake'.

Use of the Nikon Comparator has enabled Servo to achieve quality standards which would have been quite impossible, by any other means. SERVOTHERM® bolometers are rated among the most accurate and reliable in the field today.

Why not investigate what a Nikon comparator can do for you? For complete details, write Dept. TE-7.

NIKON INCORPORATED INSTRUMENT DIVISION · 111 FIFTH AVENUE, NEW YORK 3, N. Y.



⅛" drill with point thinned, negative rake — four chip cutter which produces small, broken-up center chip.	⅛" drill with point thinned, 27% cutting lip reduction, negative rake — four chip cutter which produces small, granular center chip.	⅛" drill with secondary relief angle, point thinned, negative rake — four chip cutter producing granulated center chip.	⅛" drill with four relief angles, projecting point, point thinned, 13.5% cutting lip reduction, negative rake — a six chip cutter producing granulated center chip, no burr.
			

only DrillPointMaster gives you this precise control of point geometry

LELAND-GIFFORD'S new DrillPointMaster will sharpen, relieve and thin any drill from #80 to .250″ diameter . . . lets you produce the ideal point geometry for any drilling job — then duplicate that point precisely time after time.

Check the many exclusive features listed at the right, then add these extra benefits:

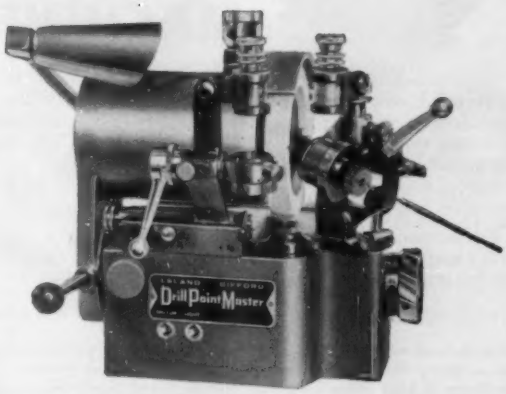
Removes only .003″ to .005″ in renewing point. Normal practice requires .030″ or more, wasting up to 90% of useful length.

Grinds at right angles to cutting edge. Conventional grinders leave grit marks parallel to lip which quickly break down, dull the tool, generate excessive heat.

Drills are centered and located by means of precision collet chuck and microscope viewers. All other methods perpetuate errors resulting from lip wear or inaccuracies in the drill.

Will grind *left hand drills* and, with a diamond wheel, does an excellent job on *carbide drills.*

Get the whole story on the Leland-Gifford DrillPointMaster. Write, wire or phone for an in-plant demonstration — or for complete information.



FEATURES

- Point angle adjustment set from 60° to 180° included angle.
- Lip relief adjustment from 0° to 26°.
- Wheel slide and point thinning carrier micrometer adjusted.
- One collet chuck serves both sharpening and thinning positions.
- Only a few collets needed for all drill sizes.
- Special sandwich wheel for clean, dry grinding and thinning without burning.
- Two variable power microscope viewers plus sealed beam light for precise setting and inspection.

LELAND-GIFFORD

WORCESTER 1, MASSACHUSETTS

DRILL POINT MASTER DRILL GRINDER

FAST, ECONOMICAL CUTTING

of ferrous, non-ferrous, non-metallic solids and shapes

STONE

M-120

manual or automatic

CUT-OFF MACHINE

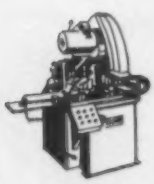
A heavy-duty, 20″-blade, chop-stroke machine, the M-120 will handle your heaviest jobs better in faster time. Cuts to close tolerances with a mill-like finish, without hardening stock or changing its characteristics. Cuts ferrous metals up to 4″ solids, 6″ structurals and heavy-wall tubing . . . and non-ferrous metals up to 6″ solids, 8″ structurals and extrusions and 6″ heavy-wall tubing.

For automatic bar feed operation the M-120 is electro-air oil-check operated for up to 1600 cuts per hour through both ferrous and non-ferrous metals.

CHECK THESE STONE FEATURES

Geared-in-head motor (a Stone exclusive) . . . fast-acting, self-centering vises . . . heavy cast machine-surfaced table for jigs and fixtures . . . wide range of gear ratios for proper spindle speed . . . oil mist spray for non-ferrous cutting.

WORLD'S MOST COMPLETE LINE



Used by every major industry throughout the civilized globe, Stone machines offer the world's most complete line of Chop-Stroke, Double Miter and Traverse-Type Machines . . . either manual, semi — or fully automatic or custom-built. All fully described in new literature featuring latest developments and improvements. Send for it today.

Stone MACHINERY CO., INC.
31 FAYETTE ST., MANLIUS, N. Y.
HIGH SPEED CUTTING MACHINERY

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on any tapping job . . .
MORE PRODUCTION PER HOUR means LOWER COST for YOU with a

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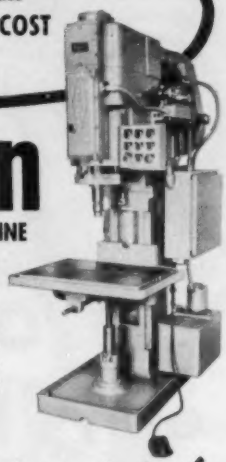
MODEL 10E-20 TAPPING MACHINE



More and more manufacturers are learning this fact from hour after hour, day after day, precision production tapping on the Kaufman 10E-20. With higher production, lower product cost, increased sales in mind — you, too, should learn all about the Kaufman 10E-20.

Get the complete facts today!

Write, wire or phone for complete information on the precision tapping machine — the Kaufman 10E-20.

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PRECISION MACHINES FOR TOP PRODUCTION
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Your Tool Design Problem may already be solved

Woodruff & Stokes specializes in solving small cutting tool design problems. Years of tool engineering and a comprehensive knowledge of multi-operational tools enable us to solve your special tool problems faster and at less cost. W & S has designed small tools that combine five machining operations in one. Many of your machining operations might well be simplified or combined by use of special tools already developed by W & S. Our stockpile of solutions represents a short cut in time and lower tool cost for you.

Write today for information on W & S tools, or for recommendations on special tool design problems.

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Center Drills • Hollow Mills • Trepans • End Mills • Hexagon Broaches Recessing and Back Chamfering Tools for Screw Machines • Spline Broaches

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Guaranteed to outperform and outlast any other LIVE CENTER.

The WHOLE HEAD turns on Double Row Ball Bearings for Radial Load and Tapered Roller Bearings for Thrust Load.

MARVEL TOOL & MACHINE CO.
1086 North River Road • St. Clair, Michigan

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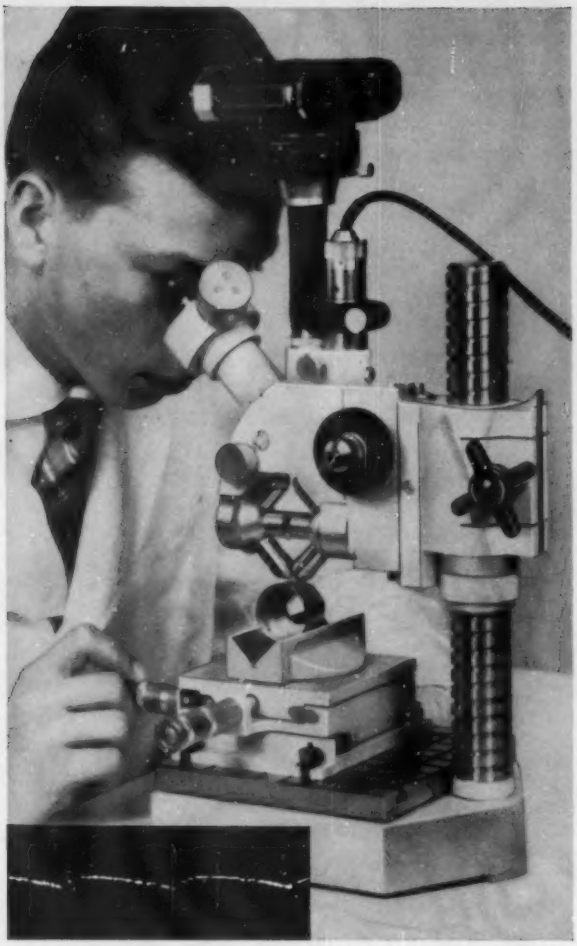


Characteristic light section photograph. Brass, faced, depth of roughness .0008 inch.

CARL ZEISS

WEST GERMANY

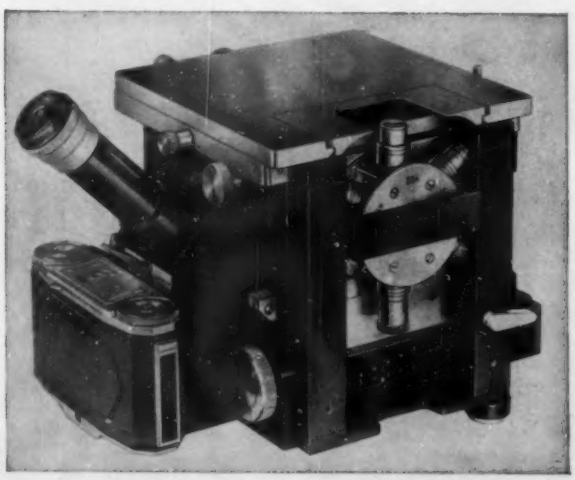
LIGHT SECTION MICROSCOPE

This microscope produces a profile of the surface being examined by the well-known light-section method without physical contact. Roughness depth, as well as the groove distances of machine-finished surfaces, can be measured. Internal surfaces can be examined by making lacquer replicas. For checking long work pieces, a special arched intermediate piece is adaptable and included in the main instrument.

The newly developed revolving nose-piece for the objectives makes it possible to quickly change the magnification (height of profile) between 400x and 200x, and the measuring range of the depths of roughness extends from .000040 to .015 inch.

Photographs for comparison and control purposes can be taken by mounting a 35mm camera on top of the instrument.

In addition to the stage plate of the stand, a mechanical stage and center cradle (for round parts) are available.



INTERFERENCE MICROSCOPE

For measuring minute depths of roughness (80 to 1.2 micro inches)

This instrument, which has magnifications of 80x, 200x and 480x, is designed especially for critical examination of super-finished surfaces, thickness of coatings, changes of surface structures due to wear, impact, stress, strain, heat, corrosion, as well as for the studying of polished and etched metallurgical specimens.

It is equipped with built-in Thallium and white light illuminators . . . A miniature camera, which is attached, provides photographs on 35mm film (1x1½").

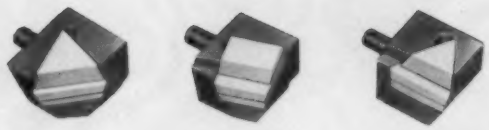
Write for literature on these instruments

CARL ZEISS, INC.

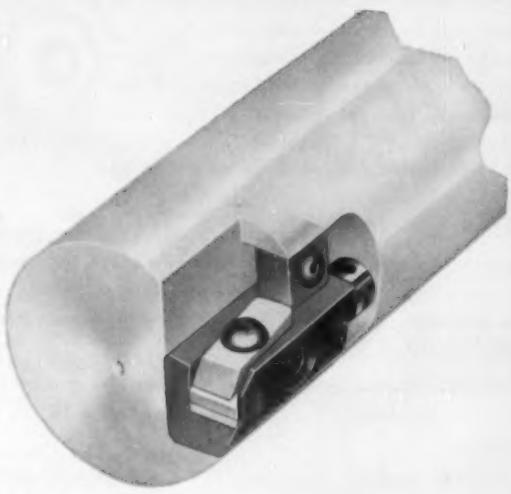
485 FIFTH AVENUE, NEW YORK 17, N. Y.

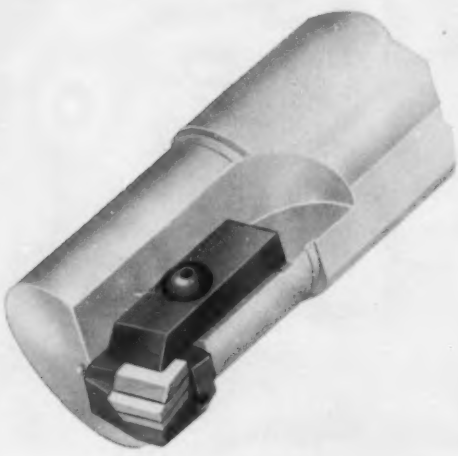
COMPLETE SERVICE FACILITIES

Two-dimensional adjustment. Positive and negative rake.



Radial adjustment. Positive rake only.





NEW KENDEX* UNITS . . .

for building special tooling more economically

These standardized Kendex units provide a versatile and economical "building block" approach to developing multiple-insert bars and heads for precision machining. They offer many advantages:

1. Only simple milling operations required to provide pockets for Kendex units—much more economical than placing inserts directly in head or bar.
2. Easy to install and remove. A small stock of standard units will service many bars and heads for different operations.
3. Easy adjustment of bore diameter and shoulder length for precision tolerances. Reduces set-up time . . . keeps expensive machines producing.
4. In case of accident, damaged units are quickly replaced.

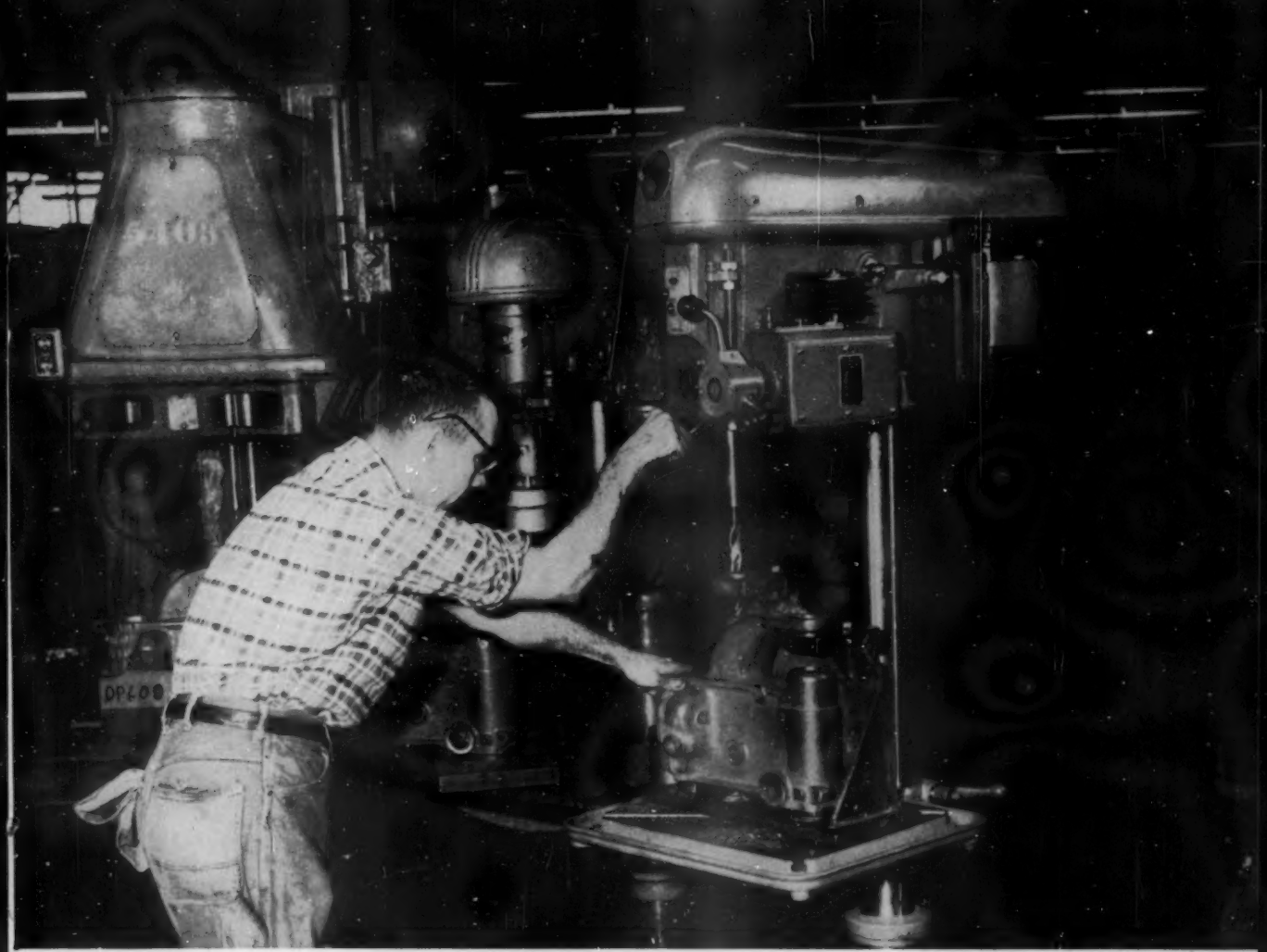
Other important features are: easy access to adjustment screws; adjustable feature permits compensating for insert wear; all units utilize standard Kendex inserts; positive chip control.

Get complete information about these new cost-cutting Kendex units from your Kennametal Carbide Engineer. Trained to analyze tooling applications and backed by our headquarters staff of tooling specialists, he may be able to help you reduce machine down time, improve production, and increase profits. Ask him for booklet "Kendex Tailored Tooling" or write direct to KENNAMETAL INC., Latrobe, Pennsylvania.

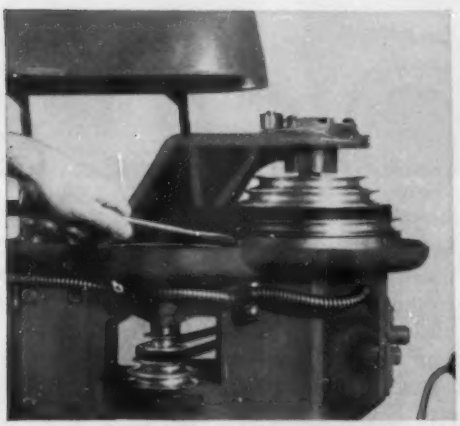
*Trademark

34230

INDUSTRY AND
KENNAMETAL
...Partners in Progress



2600 rpm or 110 rpm—you can do more with a Delta 20" *geared pulley head* drill press



All you have to do is turn a key to change from direct belt drive to gear drive on any one of the 28 models of this machine. The 20" geared pulley head drill presses can be used in manual as well as semi and fully automated set-ups to meet a variety of production needs.

FREE BROCHURE describes complete line of 20" drill presses in floor, bench, multiple spindle and overhead models. Write: Rockwell Manufacturing Company, Delta Power Tool Division, 620G N. Lexington Ave., Pittsburgh 8, Pa.

You can drill and tap large holes, do spot facing, reaming and counter-boring at extra slow speeds because these drill presses have planetary gear spindle pulleys which reduce spindle speeds and multiply torque. Hand feed models offer ten speeds, five in direct drive and five in gear drive, while eight speeds are standard on power feed models. Use of a longer than standard belt adds eight more speed selections to either model.

These rugged flexible drill presses have the capacity to handle production metalworking jobs done by machines costing more than twice as much! See them in action and learn how they can help you cut drilling costs and improve drilling quality. Your Delta Industrial Distributor (listed under TOOLS or MACHINE TOOLS in the Yellow Pages) will give you the facts and figures.

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

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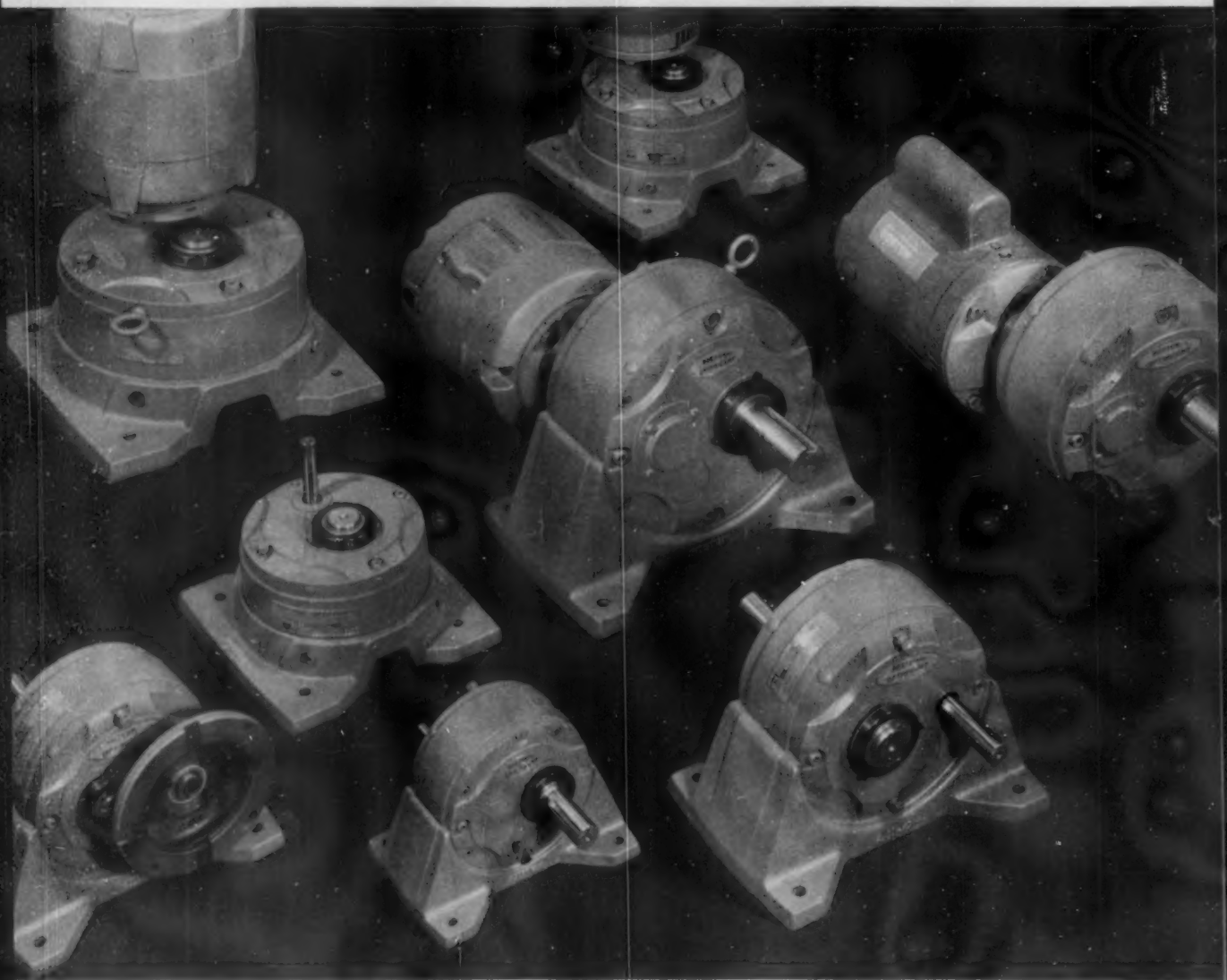
BOSTON Gear® QUALITY . . . OPTIMOUNT® ADAPTABILITY

largest selection of standard models **from stock**
simplifies design for speed reduction economy



Helical geared Ratiomotors and Reductors – single or double reduction.
For 1/6 to 15 HP drives. Horizontal or vertical base mounted, or shaft mounted.
680 mounting combinations **from stock** – meet any in-line need.
Furnished ready to install, by local Distributors.
Specify **OPTIMOUNT.** Save extra cost of special gearhead motors.
Save design time. See Catalog 57 for complete listings.
IN STOCK at your nearby DISTRIBUTOR

BOSTON Gear®

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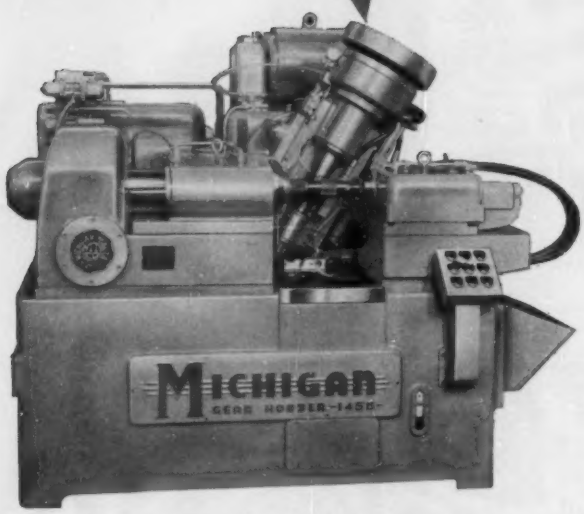
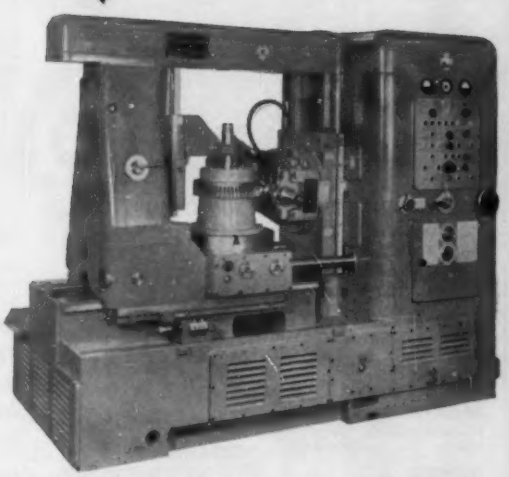
Why EUROPE wanted U.S. hobbers

Why WE added LORENZ (GERMAN) designs



Michigan 1458B hobbers are available for gears up to 12" OD and 4¾" face width. Ask for Bulletin #1458-61.



Michigan-Lorenz hobbers are available in 3 styles for gears up to 24" capacity. Ask for Bulletin #ML-61.

IN EUROPE, industry has extensively switched to mass production methods and equipment. This calls for machines that will stand the gaff day after day in continuous production. One major company decided to test all hobbers . . . European and American. The MICHIGAN 1458B hobber was found the ideal machine despite higher cost than for European machines. It gave top output, high accuracy, minimum downtime, freedom from service troubles. Since then, Europe has been a repeat buyer of 1458B hobbers.

If you want to cut your production hobbing costs, you too will find the 1458B the machine that can really do it.

IN THE UNITED STATES, gear producers who needed more versatility with high accuracy and low cost have eyed European hobbers for some time. Michigan Tool Company joined them and found that the design of the German Lorenz line of hobbers came closest to meeting U.S. needs. An engineering arrangement was made and today, as the MICHIGAN-LORENZ line, these versatile hobbers are available as American-built machines produced by Michigan Tool Company.

If you need top versatility with accuracy and ruggedness—you too will find MICHIGAN-LORENZ hobbers (and shapers) will cut your costs.

MICHIGAN TOOL COMPANY, 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

5 WAYS..... TO MAKE SET-UPS EASIER....QUICKER

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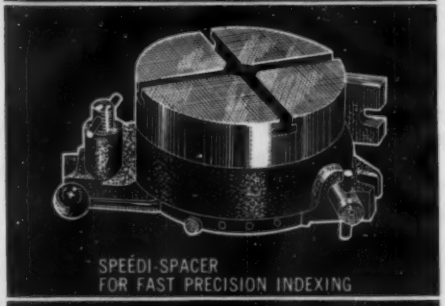

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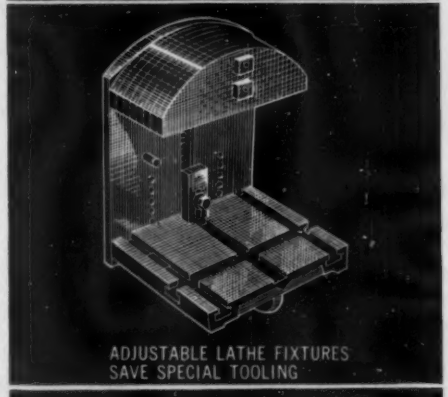

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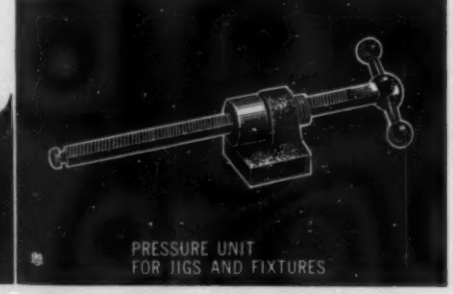

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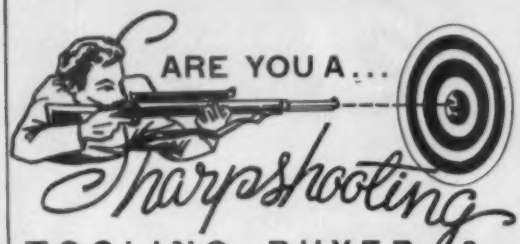

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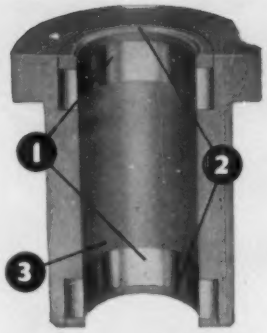

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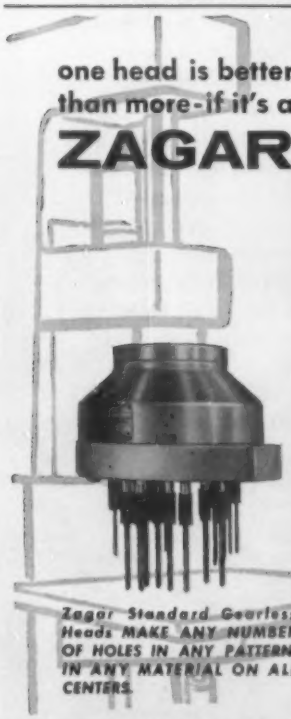

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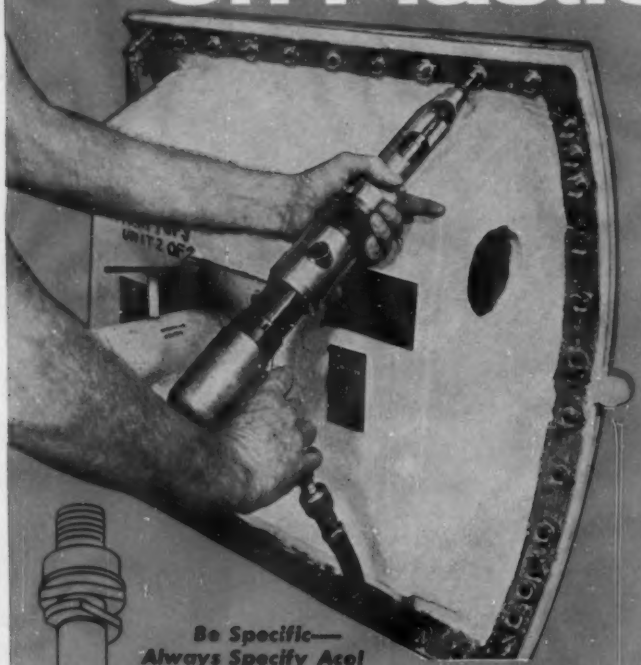

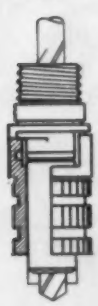

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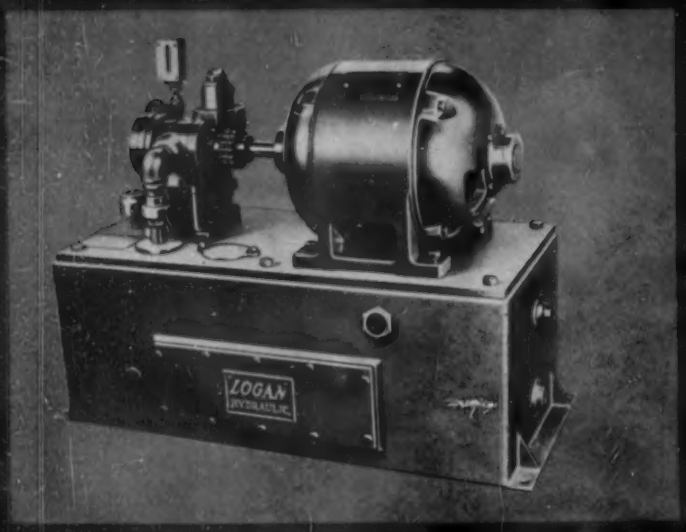

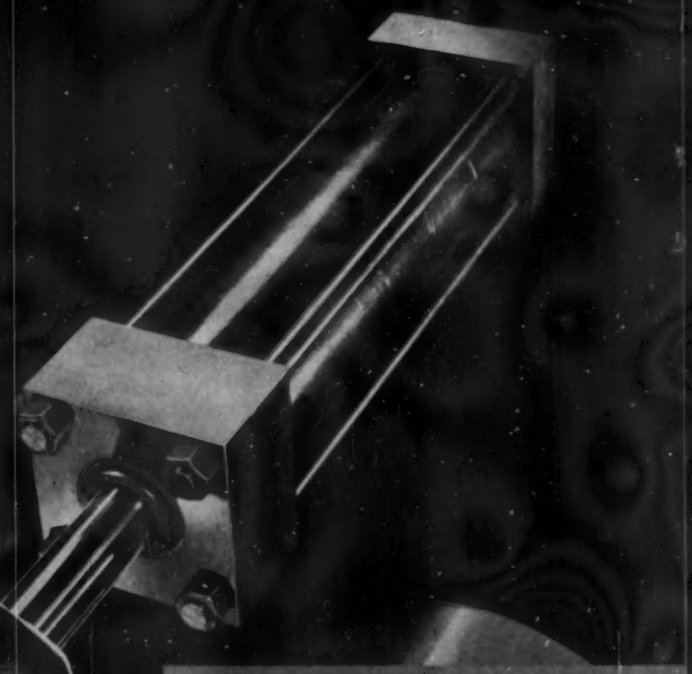

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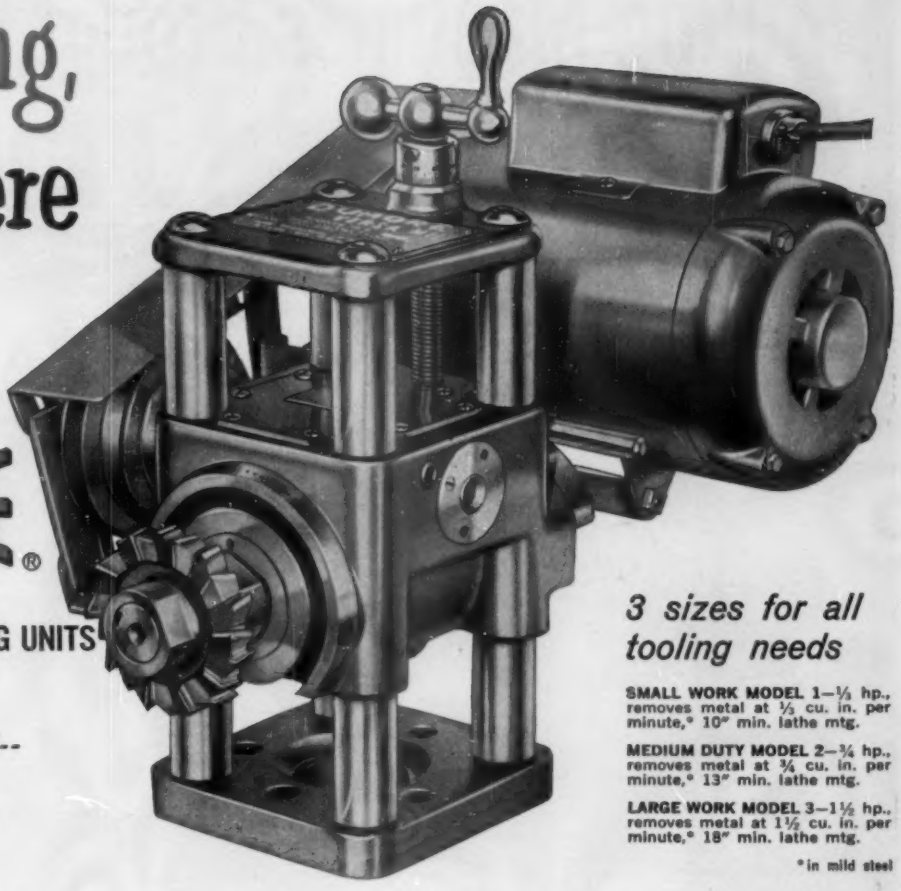

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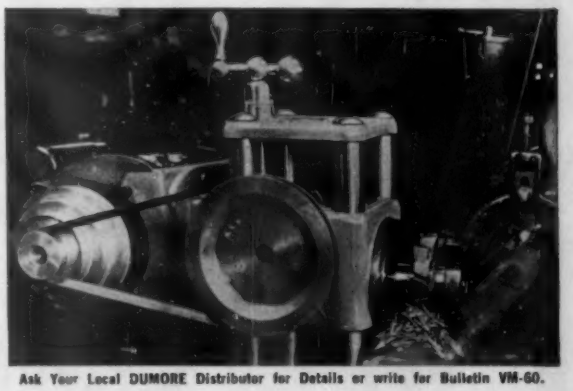

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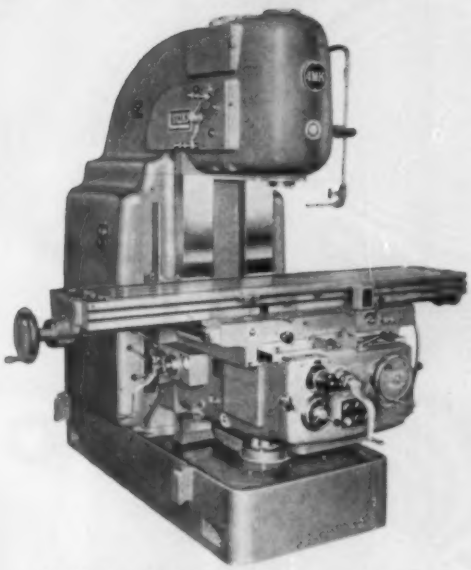
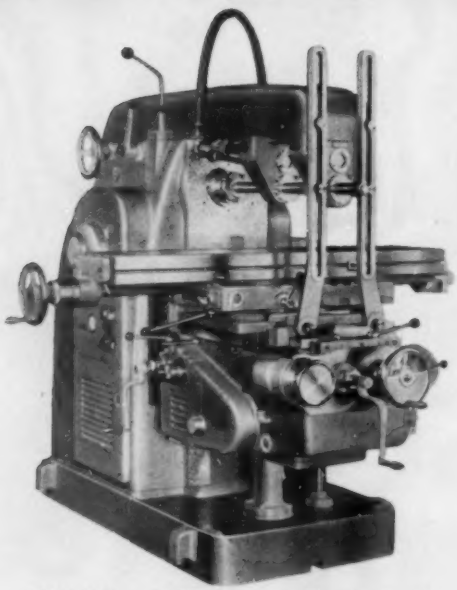
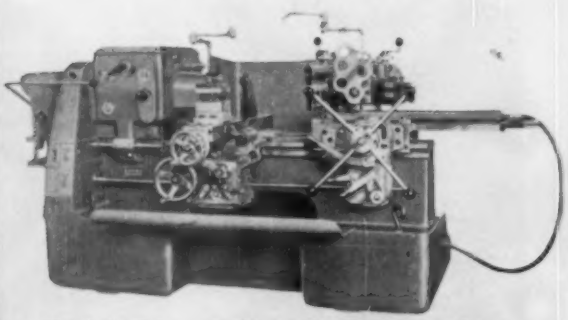


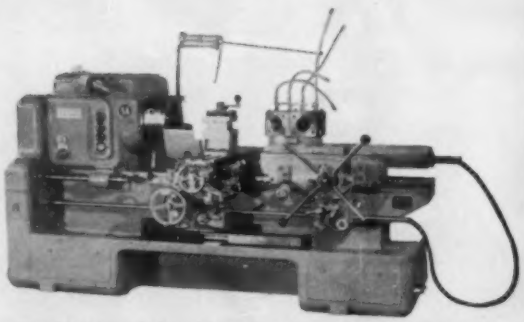
Model 4MK Heavy Duty Milling Machine (Vertical Type)



Model 2ML Medium Duty Milling Machine (Universal Type)



Model 4A Universal Turret Lathe



Model 5A Universal Turret Lathe

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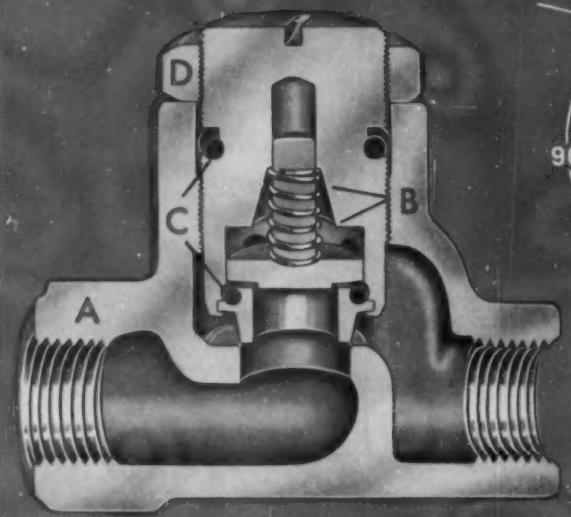

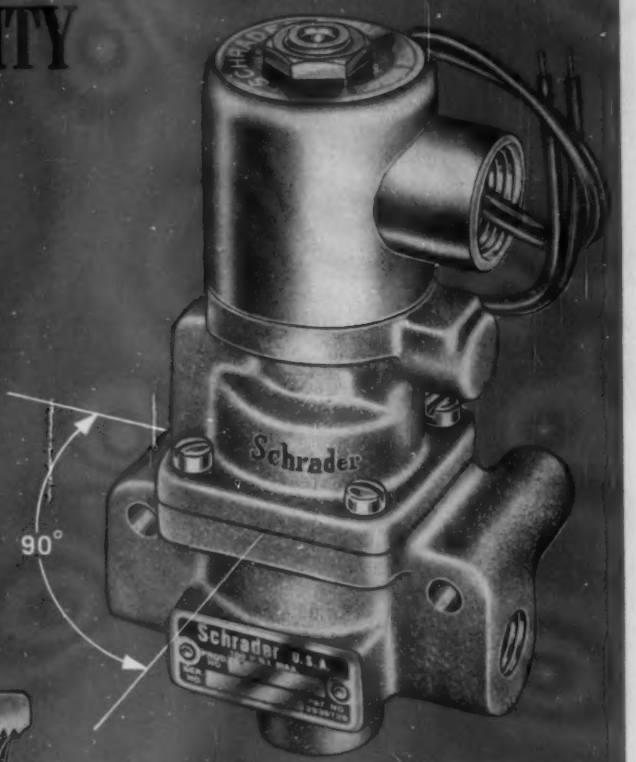

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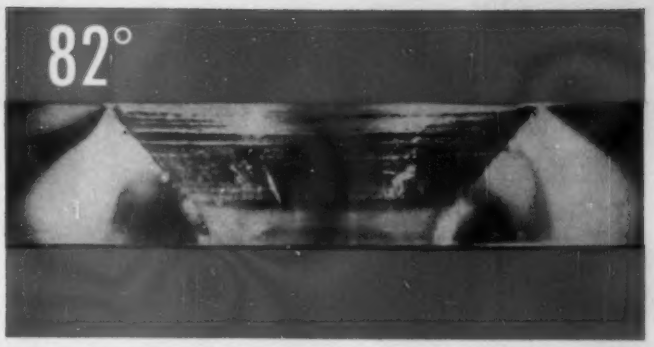
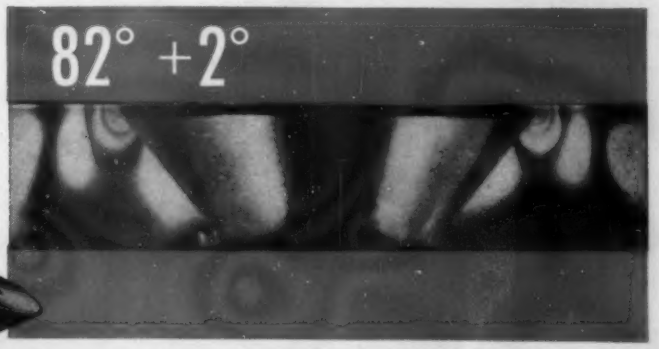
PQA* proves it...

this Allen Flat Head Cap Screw has complete all-around head contact



PQA makes it certain that an Allen Flat Head Cap Screw has contact throughout the angle of the head with the mating countersunk hole. This assures the strongest possible fastening. In this photo, made with polarized light, you can see the stress points throughout the chamfer.



Industry standards allow a tolerance of +2° in the head angle. Allen Flat Heads manufactured to this tolerance have greater bearing at the top of the head—shown by the stress patterns in this polarized light photograph.

*PRODUCT QUALITY ASSURANCE

Industry also allows a tolerance of −2° in the head angle. *But Allen does not utilize this negative tolerance.* The reason—it is entirely possible to have head seating efficiency reduced because of excessive interference in the head-shank area. The photo shows high bearing stress in this area—with risk of breaking prematurely.

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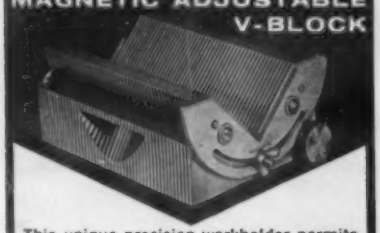

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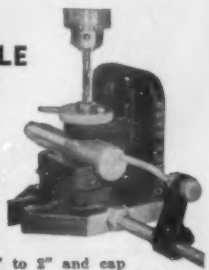

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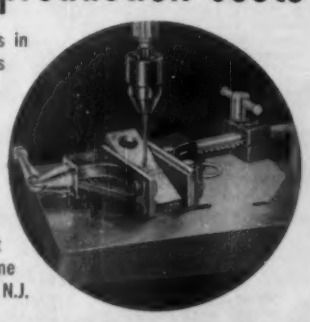

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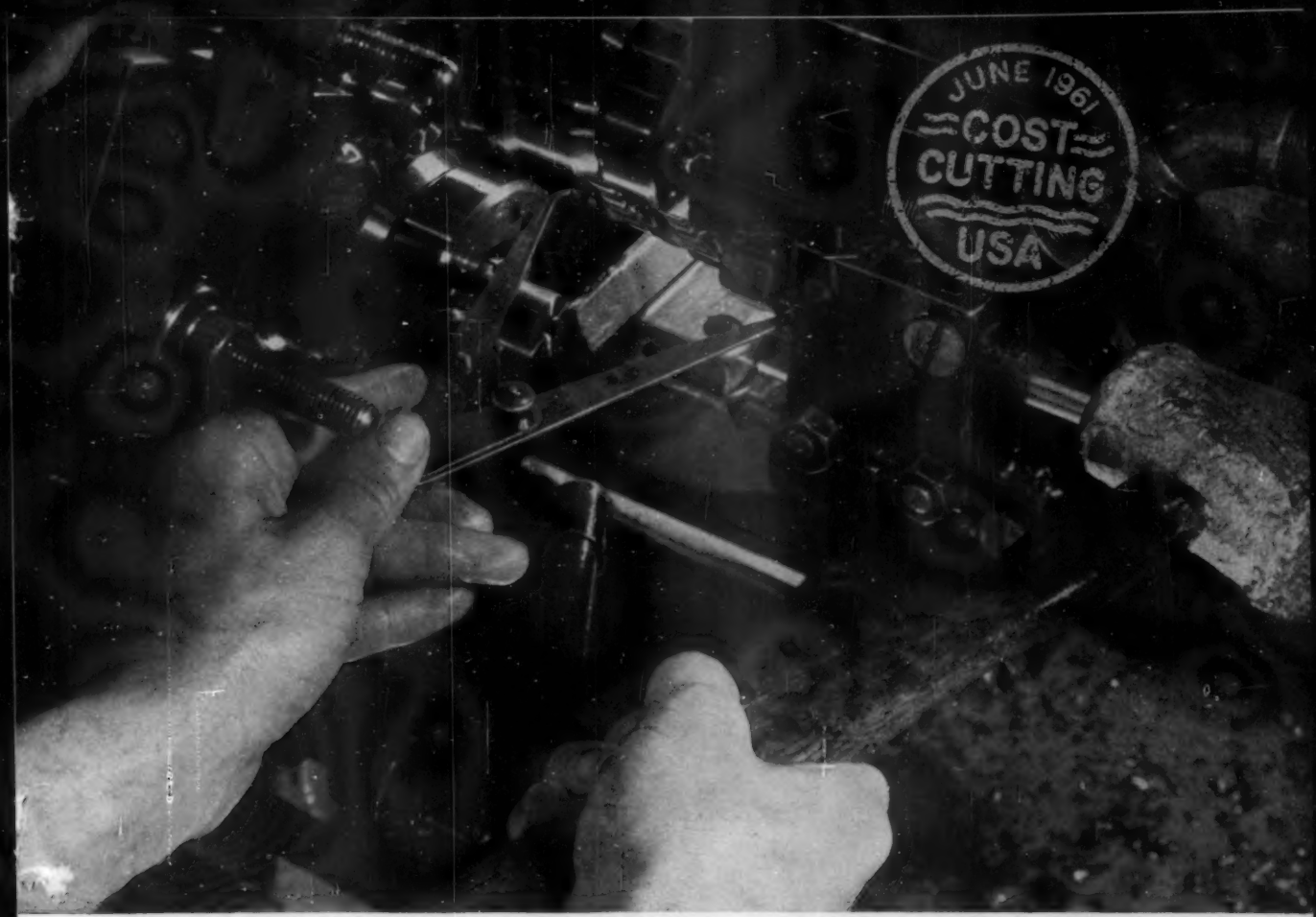

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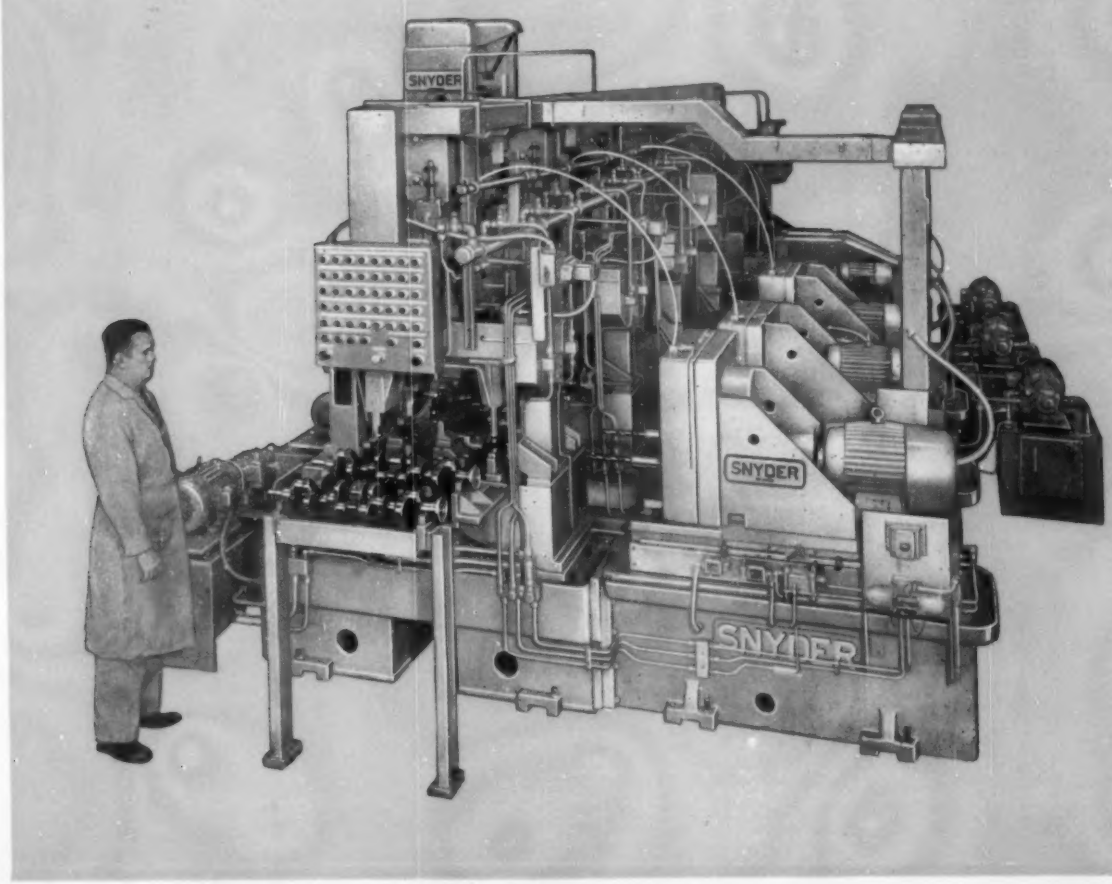

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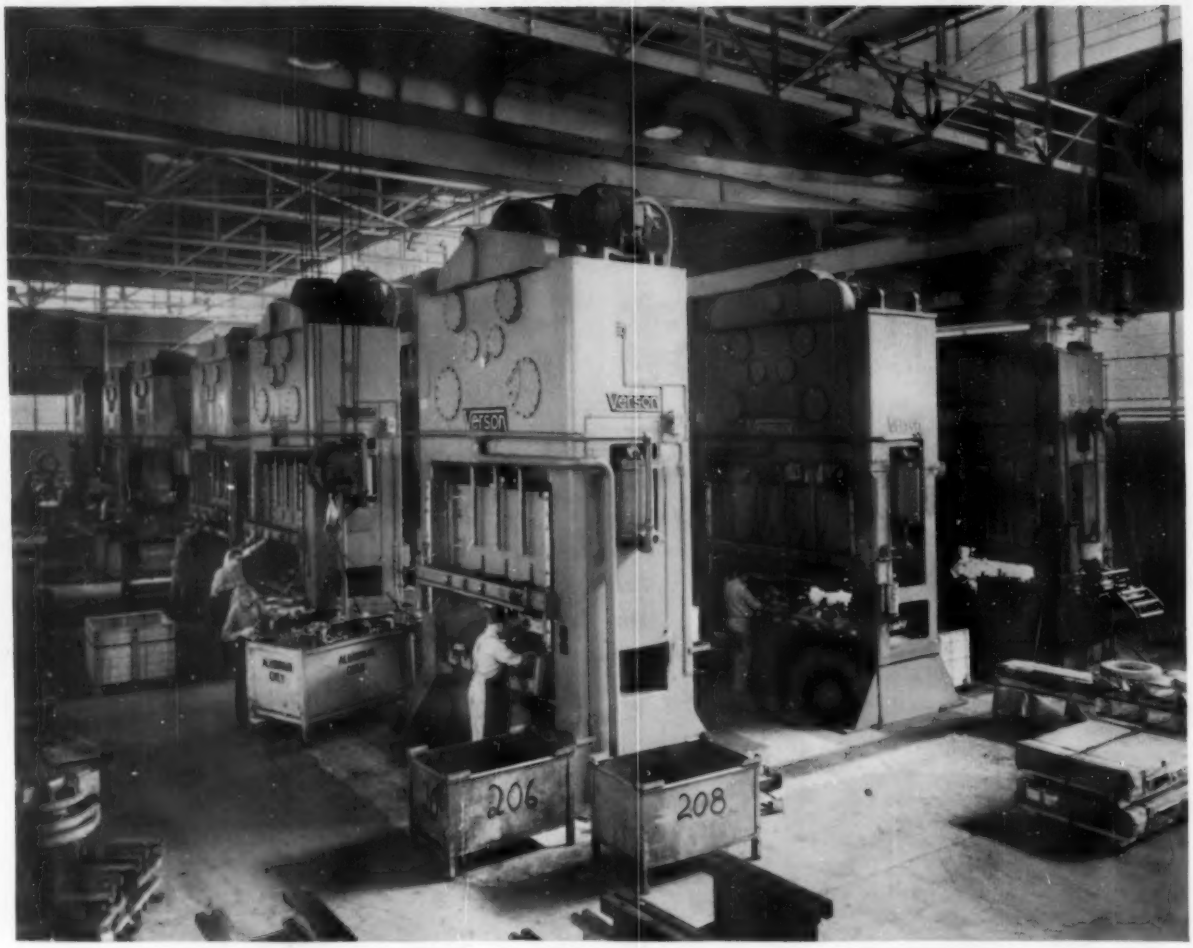

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